WIRE AND WIRE PRODUCTS

OCTOBER, 1948

For Fast, Efficient, Dependable Wire Production...

See pages 912, A, B, C, D

PROFITABLY USED BY LEADING WIRE MILLS SINCE 1871

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U. S. A.

V

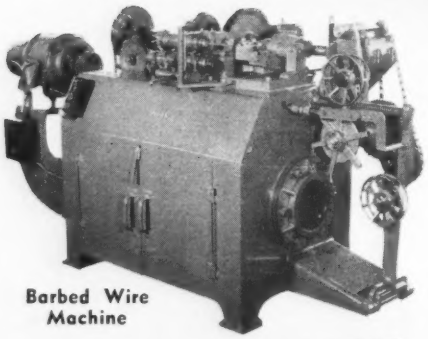
Vaughn

WIRE DRAWING MACHINERY

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

Wean EQUIPMENT Corporation

8-inch Single Strand
Wire Flattening Mill
With Wire Straighteners



Barbed Wire
Machine

The WEAN EQUIPMENT CORPORATION is recognized as a specialist in high-efficiency strip and wire mill equipment.

COLD ROLLING MACHINERY

For 36" Wide Material and Narrower

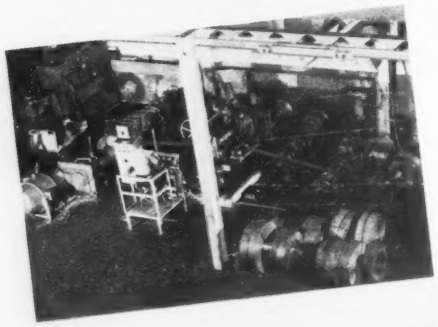
MILLS — REELS — SLITTERS — LEVELERS
COILERS — EDGERS — SCALE BREAKERS — SHEARS
SCRAP BALLERS — CONTINUOUS PICKLING

WIRE MILL EQUIPMENT

PATENTING, GALVANIZING AND TINNING TAKE-UP FRAMES
WIRE FLATTENING MILLS — SPOOLERS
NAIL GALVANIZING AND BLUEING MACHINES
BARBED WIRE AND FIELD FENCE MACHINES

WEAN EQUIPMENT CORPORATION

CLEVELAND • OHIO

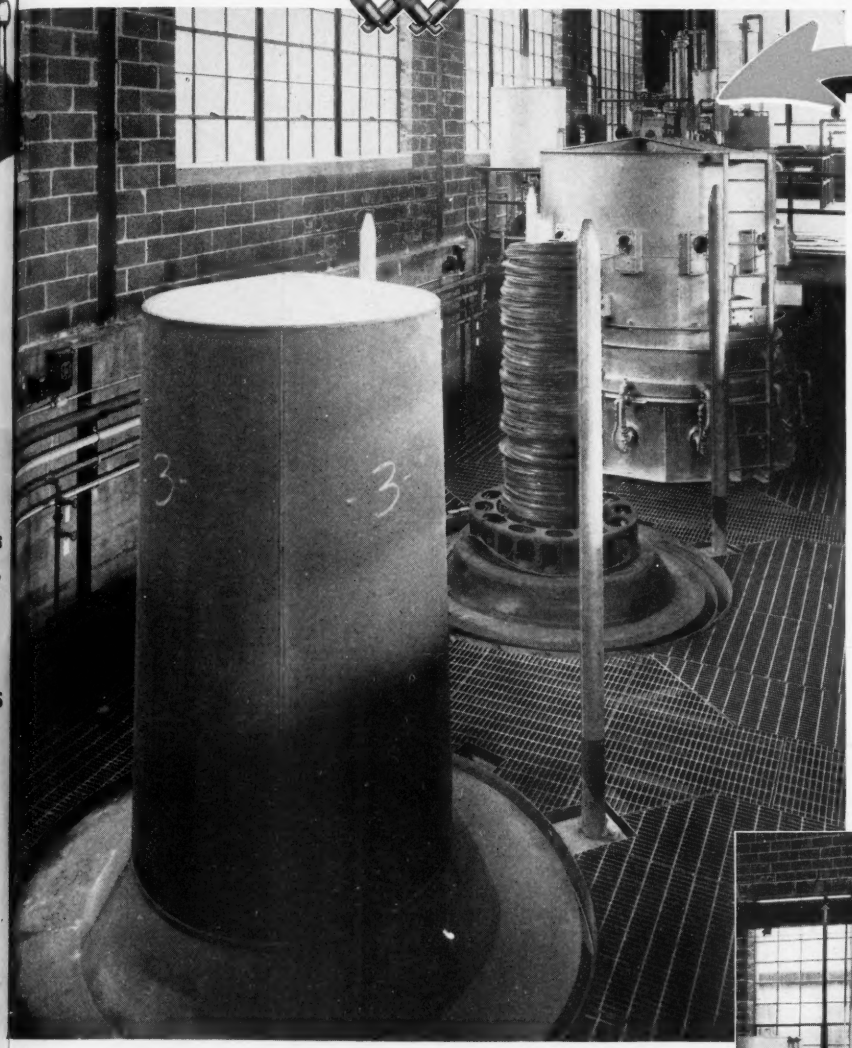


Wean
Slitting Line

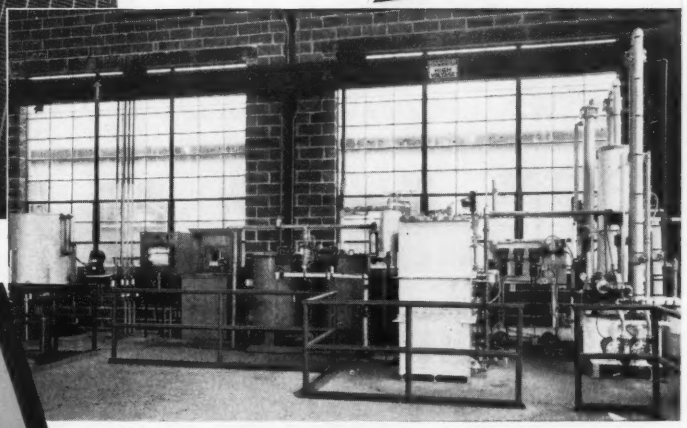
No. 1155
Field Fence
Machine

FOR ANNEALING THE HIGHEST QUALITY HIGH CARBON ROD and WIRE COILS — *The New England High Carbon Wire Co.* INSTALLED

THIS ILSON EQUIPMENT . . . .



DRY NITROGEN GENERATING *Equipment*



ENGINEERED AND CONSTRUCTED BY THE

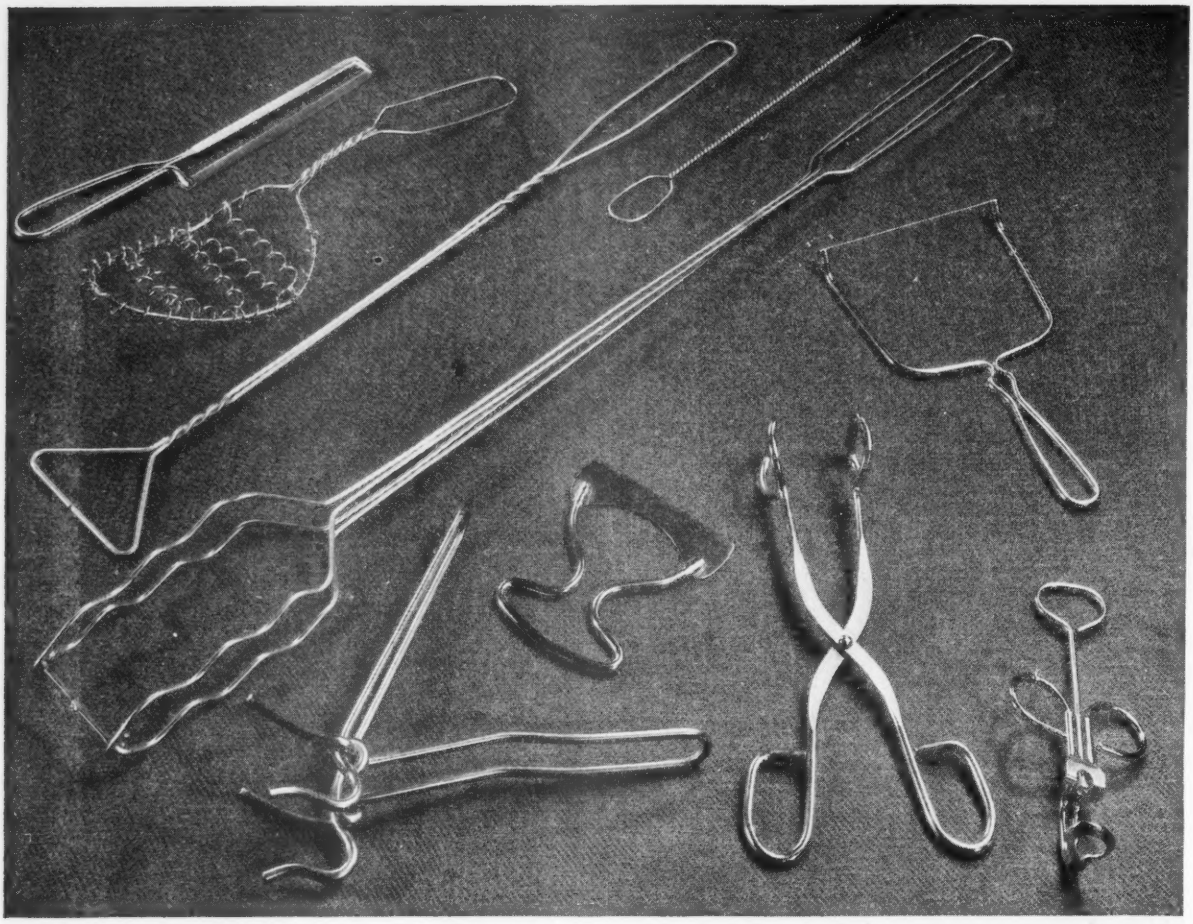
Lee Wilson

ENGINEERING CO., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

INDUSTRIAL FURNACES • RADIANT TUBE HEATING • HEAT TREATING PROCESSES



HANDLE WITH WIRE

There's no handle more convenient and economical than one made from steel wire—whether it's for an egg whipper, a pair of tongs, or a brush. Handles are just one example of thousands of uses where steel wire does a better job than any other material.

Bethlehem Wire is made in a complete range of standard and special grades to meet exacting requirements, whether you're interested in handles, hair pins, or high-strength telephone wire.

In our modern mills we manufacture low-, medium-, and high-carbon steel wire . . . with or without heat-treatment . . . to meet rigid standards of physical and mechanical properties needed for specific end uses.

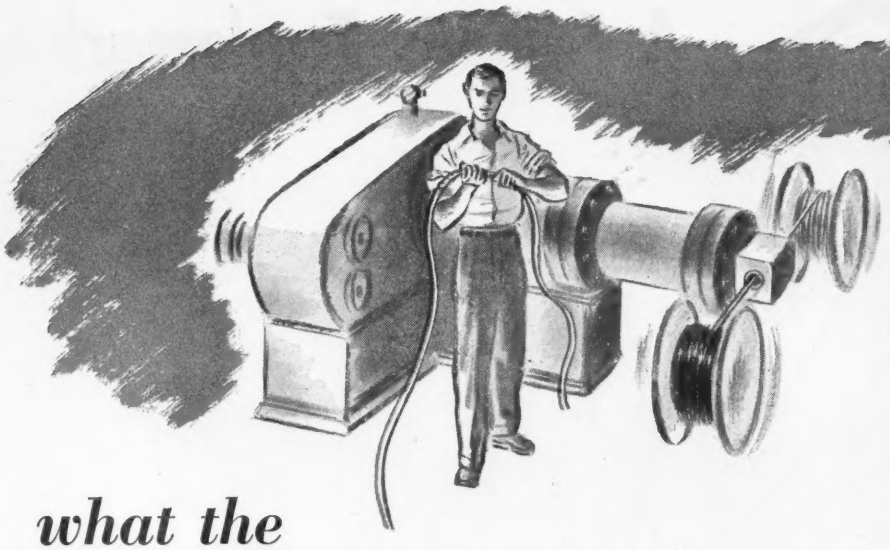
We've made steel wire of so many different kinds that your requirements are likely to be very similar to some grade we have furnished in the past. The demand for our wire continues to exceed production, but now is a good time to let us work with you in planning best results with your wire products.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM WIRE

BETHLEHEM STEEL

WIRE & WIRE PRODUCTS, Vol. No. 10, October, 1948. Publication Office, at 61 Cliff Street, New York 7, N. Y. Executive Office, 300 Main Street, Stamford, Conn. Published monthly by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secy. and Treas. Subscription price: U. S., $5.00; Canada, $5.00 per year; 50 cents per copy; Foreign, $7.50 per year. Entered as second class matter, June 14, 1946, at the Post Office, New York, N. Y., under Act of March 3, 1879.



what the WELL-DRESSED WIRE *will wear!*

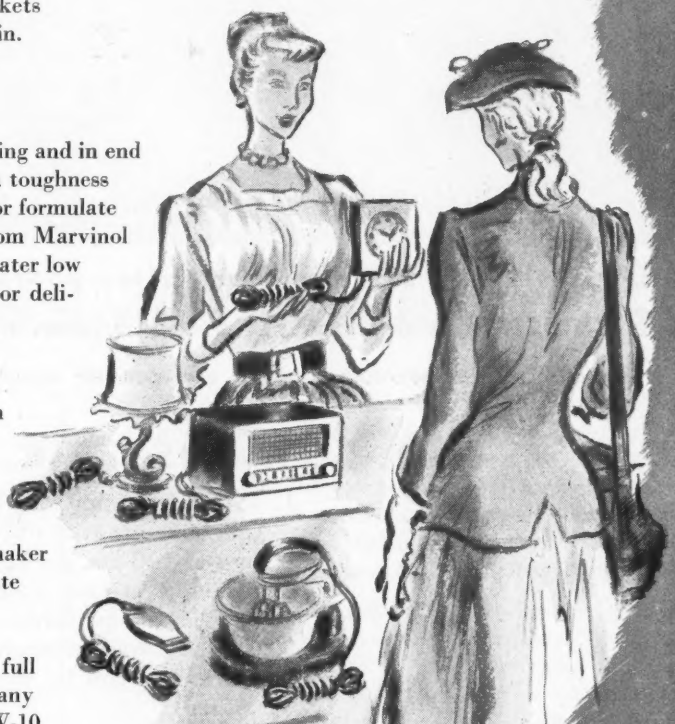
THERE'S a new look for wire, too . . . jackets made from Marvinol®, the better vinyl resin. Look at these advantages Marvinol offers!

MORE STABILITY!

Marvinol offers superior stability in processing and in end products. High molecular weight gives extra toughness . . . yet it is easy to extrude, injection mold or formulate by other processes. Wire covering made from Marvinol has greater resistance to heat and light, greater low temperature flexibility, may be brilliantly or delicately colored.

MORE UNIFORMITY!

Marvinol resins are a development of Martin research and Martin's quarter-century of plastics experience. They're being produced in the world's most modern chemical plant to assure you of unexcelled uniformity. The Glenn L. Martin Company, maker of Marvinol, does not compound or fabricate in the plastics field. If you coat, buy or use wire, our sales engineers and fully equipped customer service laboratory offer full technical cooperation. Write on your company letterhead to: Chemicals Division, Dept. W-10, The Glenn L. Martin Company, Baltimore 3, Md.



Martin ® Marvinol

RESINS, PLASTICIZERS AND STABILIZERS, PRODUCED BY THE CHEMICALS DIVISION OF
THE GLENN L. MARTIN COMPANY • AN INTERNATIONAL INSTITUTION
"BETTER PRODUCTS, GREATER PROGRESS, ARE MADE BY MARTIN"

A Famous Trademark...

On A "Work-Horse" Air Cylinder At A "Work-Horse" Price!

DESIGNED by JLE engineers after years of research in pneumatics!

PRODUCED under same rigid supervision that governs all JLE equipment!

TESTED and approved on JLE equipment used throughout the wire industry!

LOW-COST AIR CYLINDER FEATURES

1. Available in standard bore sizes from 1½" to 10" diameter. Can be made in any stroke specified. Has top operating pressure of 110 lbs. per sq. inch.
2. Available in four standard mountings. Standard piston rod attachments available.
3. Can be furnished single or double-acting.
4. Cushioning can be supplied on either one or both ends, if desired.

Ask for complete JLE Air Cylinder details and prices —

JAMES L. ENTWISTLE CO.

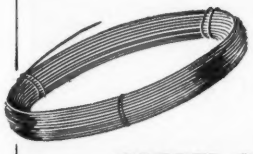
43 CHURCH STREET, PAWTUCKET, RHODE ISLAND

30 YEARS OF SERVICE TO THE WIRE INDUSTRY

Canadian Representatives:
THE A. R. WILLIAMS MACH. CO., LTD.
64 FRONT ST. W.
TORONTO, ONT.

British Associates:
GENERAL ENGINEERING CO., LTD.,
BURY ROAD, RADCLIFFE,
LANCS., ENGLAND

LET *CHASE* CONTROL YOUR TEMPER!



For your convenience, there are 22 *different* copper alloys in wire form *regularly* produced by Chase.

COPPER-ALLOY WIRE

Insist on clean, bright wire with perfect "cast" . . . the characteristic of uncoiling uniformly and without twist . . . for a perfect product every time. Let Chase control your temper with the finest in wire and service!

LET Chase supply you with *copper-alloy wire* of such fine temper that there's no opportunity for you to lose yours over the prospect of a distorted product. Uniformity of temper in different directions largely determines whether wire being headed, extruded or otherwise plastically formed will flow uniformly and avoid giving you a badly formed product.

Wire produced in the Chase mills undergoes a series of severe tests to assure this precise adjustment of temper and control of grain size—plus uniform surface texture and color, accuracy of dimensions, complete freedom from physical defects. For the best, go to the best possible source . . . call Chase today!

Chase

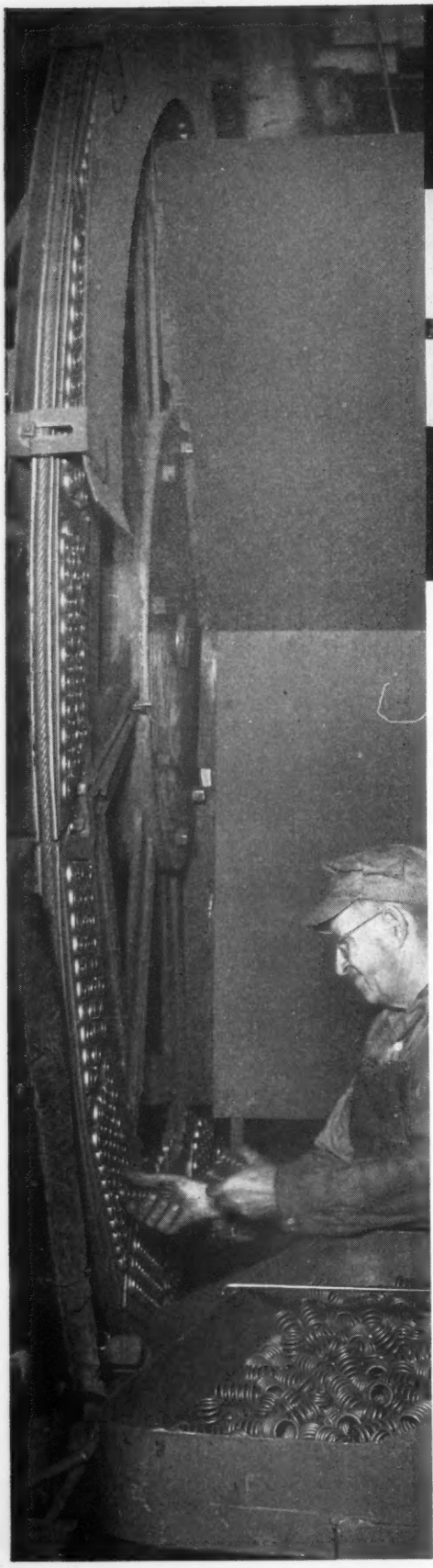
the Nation's Headquarters for
BRASS & COPPER

WATERBURY 91, CONNECTICUT

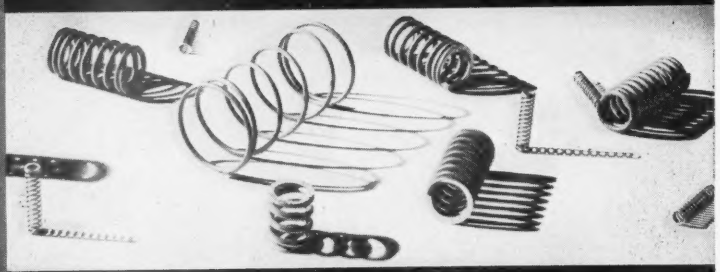
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WATERBURY (†Indicates Sales Office Only)



GRIND MORE
Per Hour . . . For Less . . .



with Fast-Cutting NORTON DISCS!

These Norton discs cut hardened steel fast and cool without danger of burrs, burning or distortion — remain flat and sharp — resist grooving — and require a minimum of dressing — that's why they produce more useable springs per hour and reduce grinding costs.

Especially popular are discs of tough, sharp 57 ALUNDUM abrasive or the sensational 32 ALUNDUM abrasive (Regular or Open Structure) with vitrified bond. They're available in all standard sizes (15" to 72" in diameter), and with all types of mountings (including plate-mounted and inserted-nut).

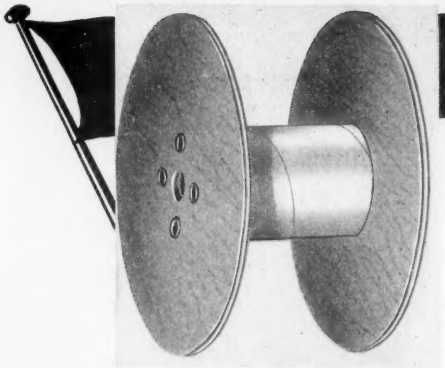
Contact your Norton abrasive engineer or distributor for exact disc specifications to meet each of your spring grinding problems.

NORTON COMPANY • WORCESTER 6, MASS.

Distributors In All Principal Cities

NORTON ABRASIVES

W-1199



WELCOME CONVENTIONEERS

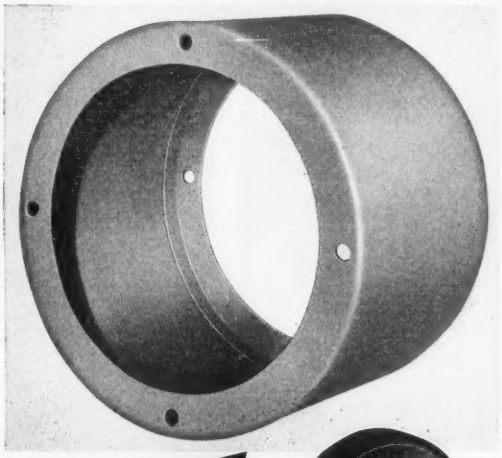
HUBBARD

Spools and Reels

BETTER PERFORMANCE

The exact balance of Hubbard spools and reels assures freedom from wire breakage at the new high speeds . . . and the other Hubbard qualities of rugged construction, minimum weight and low cost add up to highest overall spool performance in the wire industry.

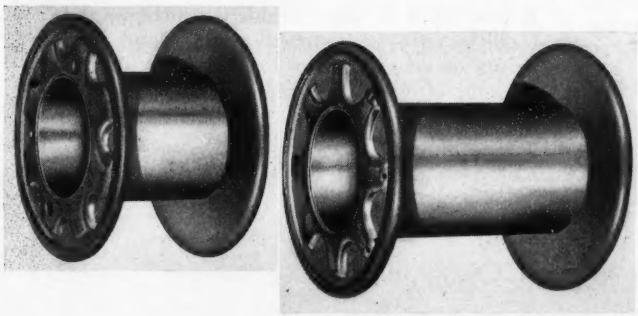
There is a size and type for every wire mill need. Shown here are a few of the many:



1. Lightweight Reels. Ideal (no return) for shipping many types of wire.
2. Steel Double-Strength Traverse. New in 1948. Double thickness flange and shoulder gives minimum weight with maximum strength where needed.
3. Metal Bound Spools and Reels for Shipping. Head of bonded plywood with die formed steel tire. For light weight and long wear.
4. Steel Process Spools. New in 1948. Steel washer design for greatest rigidity. All joints brazed and smooth finished. For all wire drawing and processing operations . . . especially recommended for handling fine wire. Built in all standard sizes.

For information on Hubbard spools, reels and traverses, write

HUBBARD SPOOL COMPANY
1624 Carroll Avenue • Chicago 12, Illinois



Hubbard

STEEL SPOOLS AND REELS . . . METAL BOUND SPOOLS AND REELS . . . STEEL TRAVERSES LIGHT WEIGHT REELS . . . WOOD REELS

ENAMELED COPPER	TWISTED MULTIPLIES	CELANESE COVERED
ENAMELED IRON	PARALLEL MULTIPLES	GLASS FIBRE COVERED
ENAMELED ALLOY	SILK COVERED	LITZENDRAHT AND
ENAMELED ALUMINUM	COTTON COVERED	SPECIALS TO ORDER

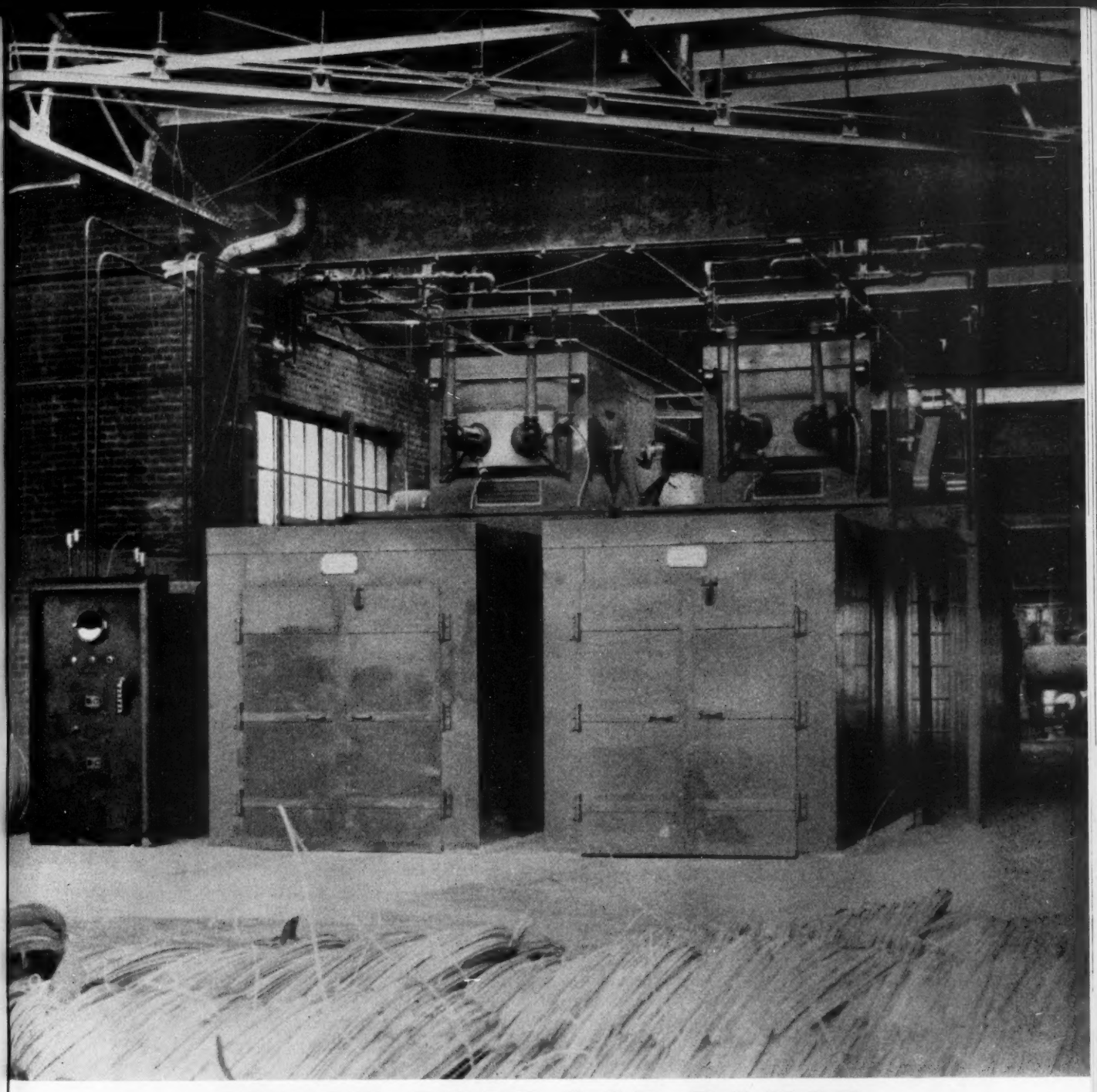
There's more to present day engineering and design problems than shortages of materials, priorities, etc. There is also the question of whether specifications have been rigidly adhered to. Wire, for example, must meet such requirements as specific electrical properties, flexibility, tensile strength, laying speed, uniformity, etc.

Whether it's a buyer's or seller's market, WINCO magnet wire products are drawn to exact specifications. Uniformity of product is guaranteed by mercury process tests and careful supervision guards against variations in consistency, structure or electrical values.

If you have a wire problem, our complete facilities are at your disposal. Send blueprints or specifications for recommendations, without obligation. Samples sent on request: write today.

WINSTED DIVISION

WINSTED HUDSON WIRE COMPANY CONNECTICUT



TRUCK-TYPE ROD BAKER

For wire mills where pit baking is too expensive, or impractical for other reasons, Industrial Ovens offers truck-type and conveyorized rod or wire bakers with many outstanding performance features. Direct or indirect fired as conditions require.

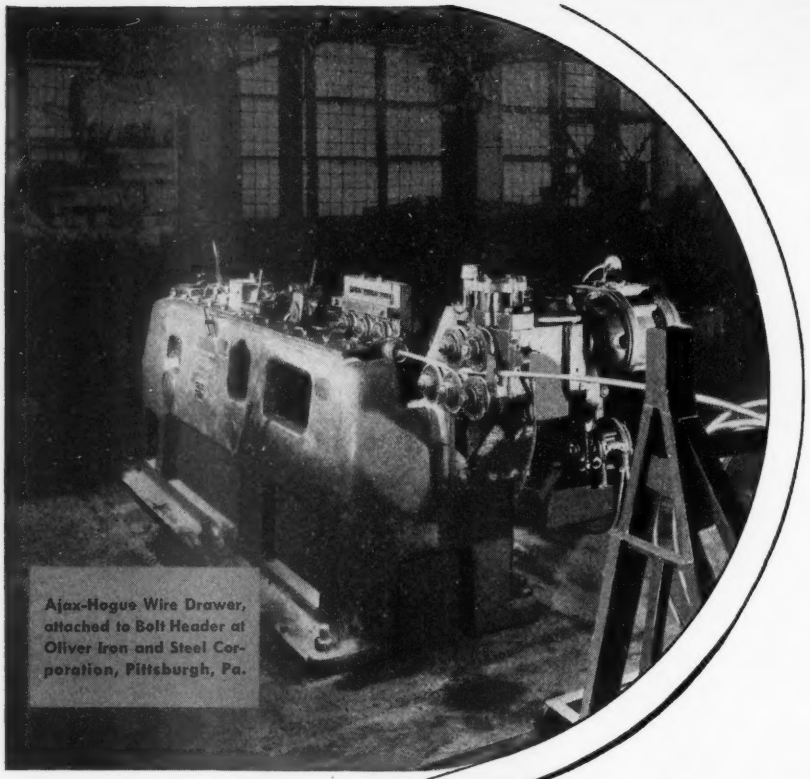
Write for full detailed information or see IOI's Engineers at the Wire Association Convention

INDUSTRIAL IOI ENGINEERING VERSATILITY **OVENS, INC.**

13825 TRISKETT ROAD CLEVELAND 11, OHIO

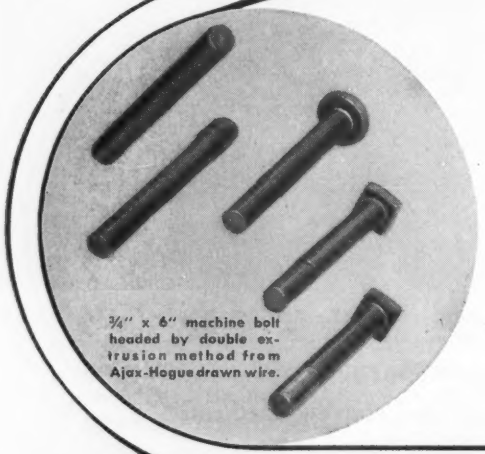
ASSOCIATED COMPANY: JAMES DAY MACHINERY LTD., LONDON W.1, ENGLAND

all types of cold headers should have



Ajax-Hogue Wire Drawer, attached to Bolt Header at Oliver Iron and Steel Corporation, Pittsburgh, Pa.

AJAX-HOGUE WIRE DRAWERS



¾" x 6" machine bolt headed by double extrusion method from Ajax-Hogue drawn wire.

The Ajax-Hogue Wire Drawer . . . a simply installed attachment for cold headers . . . cold draws, coats and supplies the heading machine with clean, accurately round wire. Substantially longer header die life, lower raw material cost, and improvement in the quality and accuracy of the product are important money saving advantages gained by the use of Ajax-Hogue Wire Drawers. No matter what makes of headers you operate or how many, you can improve cold heading efficiency with Ajax-Hogue Wire Drawers.

WRITE FOR BULLETIN No. 111.

THE Ajax MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND 17, OHIO

110 S. DEARBORN ST. CHICAGO 3, ILLINOIS

DEWART BUILDING NEW LONDON, CONN.

THESE WIRE GOODS NEED NO PROTECTION...

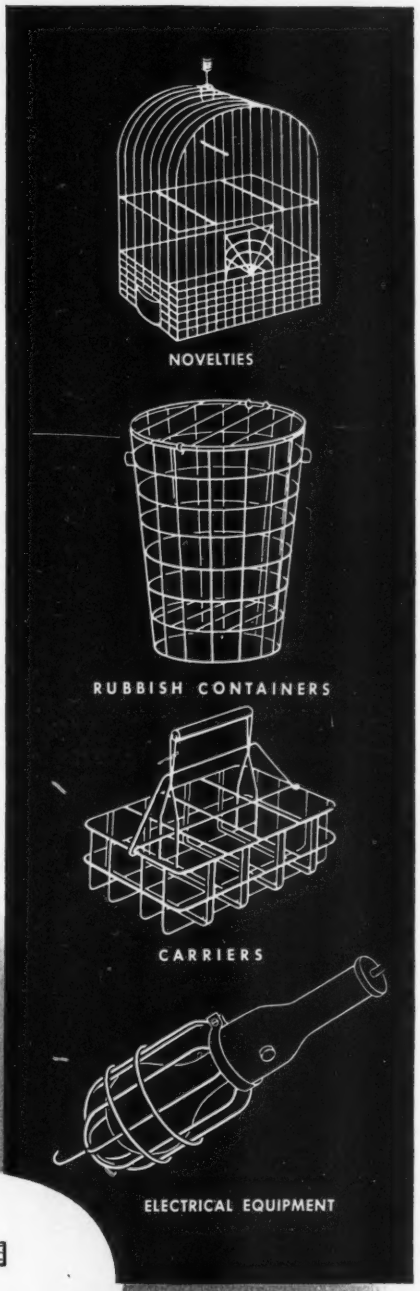
THEY'RE ALCOA ALUMINUM

Alcoa Aluminum Wire offers freedom from finishing costs. No special coating is necessary, for its naturally bright surface resists atmospheric attack . . . stays free from red rust.

If you want color, use the patented Alumilite process to give your fabricated wire products any shade of the rainbow. The color can't chip or peel because it's *in* the surface of the metal.

Painted and plated finishes are more durable on Alcoa Aluminum Wire.

Ask your nearby Alcoa sales office about the variety of alloys and tempers of aluminum wire in all standard shapes and gauges. ALUMINUM COMPANY OF AMERICA, 1828 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in 55 leading cities.



A FOOT

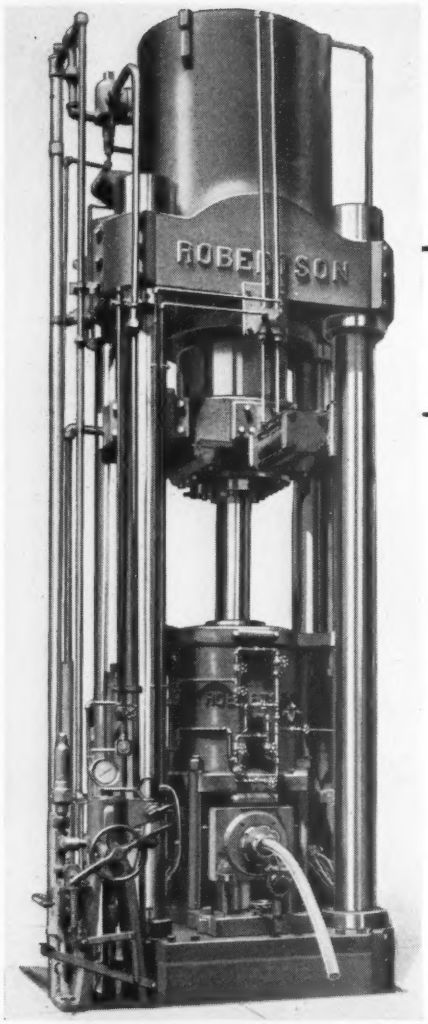
BECOMES A YARD

WHEN YOU USE ALCOA ALUMINUM WIRE

ALCOA FIRST IN ALUMINUM

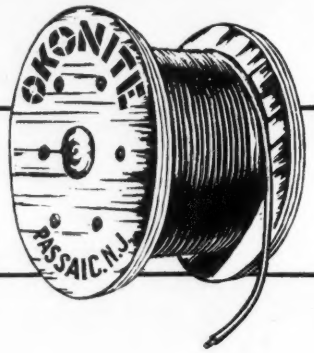
ALCOA ALUMINUM 1888 1948 60 YEARS OF SERVICE

Another Satisfied Robertson USER...



OKONITE SINCE 1878

OKONITE



Uniformly steady output . . . low operating costs . . . and minimum maintenance are characteristic of Robertson Lead Encasing Presses and other Hydraulic Equipment. That's why leaders in the Wire and Cable Industry, like Okonite and many others, specify and use this equipment.

The knowledge and experience, of more than 90 years' specialization in the design and manufacture of high pressure hydraulic equipment, are at your service to help you solve your lead encasing problems. Consult us for detailed information.

JOHN Robertson COMPANY, INCORPORATED

125-137 WATER STREET, BROOKLYN 1, NEW YORK

Designers and Builders of all Types of Lead Encasing Machinery

Since 1858

Signs to remember when you need wire

For over a century we have been producing steel wire of superior quality for more than 160,000 different manufacturing uses.

We produce wire in a wide variety of shapes and sizes. Round wire, flat wire, square wire, oval wire, hexagonal wire. Wire that is hard, soft, stiff or ductile. Wire for nails, screws, nuts or bolts. Wire for upholstery springs, tire chains, paper clips. Wire that is plain, tinned or bright finished. Wire of every analysis—carbon, alloy or stainless steel. In the event that your needs require a type that we do not regularly produce, then you can depend upon our engineers to draw wire that will fit your needs exactly.

While at present, the demand for our high quality wire products far exceeds the supply, we are doing our utmost to fulfill our customers' needs.

In the meantime, our staff of highly trained metallurgical engineers will gladly help you to determine which American Quality Wire is best suited to your needs—that will provide trouble-free production and help insure satisfactory performance of your product.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

AMERICAN MANUFACTURERS WIRE

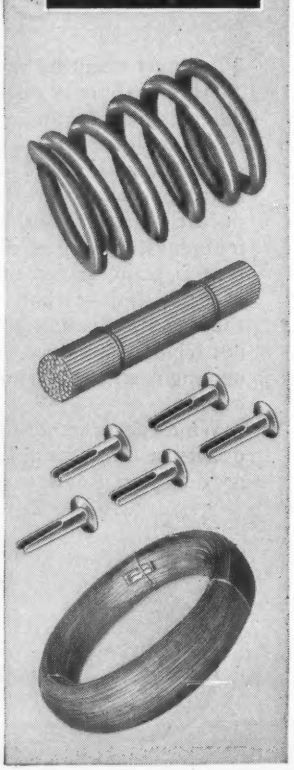
UNITED STATES STEEL

Of course you are coming to The Wire Association Convention, Hotel William Penn, Pittsburgh, October 18th through the 22nd.

Your Committee has prepared an outstanding program including an inspection of the new wire-making facilities at the J&L Aliquippa Works.

Here you will see the latest type wire drawing machines . . . new rod-cleaning unit . . . new annealing and tempering equipment—all a part of J&L's $2,000,000 program to make this wire mill the finest in the Industry.

You will see J&L *quality-controlled* wire in the making. You'll see how J&L's system of closely integrated quality control gives you the finest wire available.



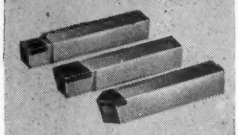
SPRING WIRE ARC WELDING WIRE FORMING WIRE LOCK WASHER WIRE
CHAIN WIRE TUBULAR AND BIFURCATED RIVET WIRE
WOOD SCREW AND MACHINE SCREW WIRE GALVANIZED WIRE

JONES & LAUGHLIN STEEL CORPORATION
PITTSBURGH 30, PA.

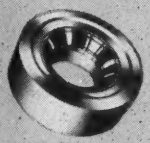
1 POUND to 1000 POUNDS

Talide
(TUNGSTEN CARBIDE)
Work Rolls

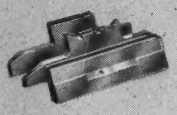
TALIDE METAL MEETS EVERY REQUIREMENT



CUTTING TOOLS

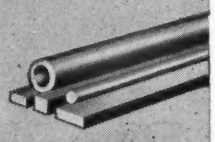


DRAWING DIES

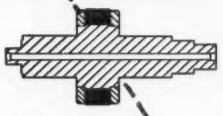


CENTERLESS BLADES

DRILL JIG BUSHINGS



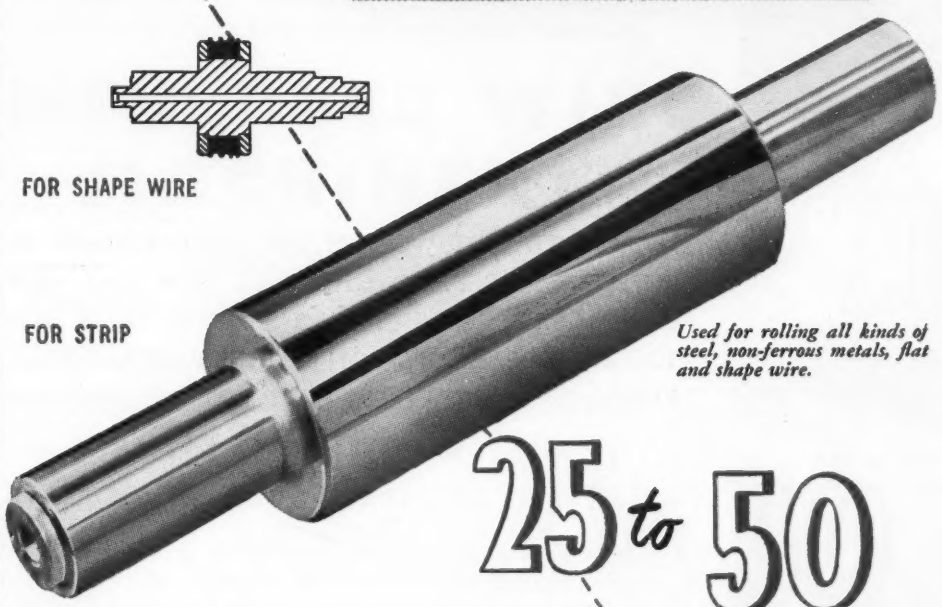
SOLID BAR STOCK



FOR FLAT WIRE

FOR SHAPE WIRE

FOR STRIP



Used for rolling all kinds of steel, non-ferrous metals, flat and shape wire.

25 to 50
times more work per grind

This solid tungsten carbide (Talide Metal) roll is the largest product ever made of tungsten carbide. Solid or sleeved, carbide rolls are an exclusive development of Metal Carbides Corporation . . . diameters up to 10" and lengths up to 40". Much harder than the hardest steel rolls, carbide rolls take and impart a mirror-like finish to the metal rolled. On production, mills report 25 to 50 times more service life per grind.

OTHER ADVANTAGES INCLUDE:

MORE PRODUCTION	CLOSER TOLERANCES
HIGHER SPEEDS	GREATER REDUCTIONS
LESS DOWN TIME	FEWER REJECTS

Carbide rolls can be reground twice as many times as steel rolls. Improved physical properties of the strip reduce cost of subsequent plating and stamping operations.

Send for Circular on TALIDE ROLLS

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METAL CARBIDES CORPORATION

YOUNGSTOWN 5, OHIO *Pioneers in Tungsten Carbide Metallurgy*

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A WELDER FOR EVERY PURPOSE

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MICRO PRODUCTS COMPANY

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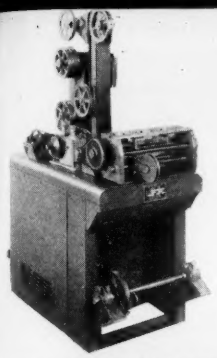
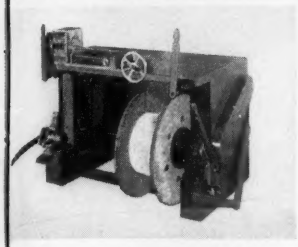
Cable address: MICROWELD, CHICAGO

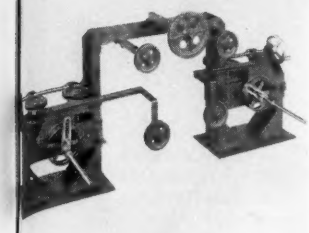
Telephone STATE 7468



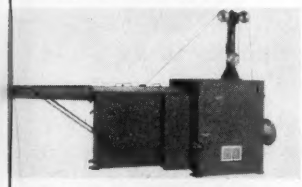
SINGLE REEL TAKEUPS



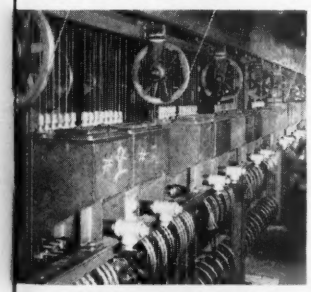
CONTINUOUS TAKEUP



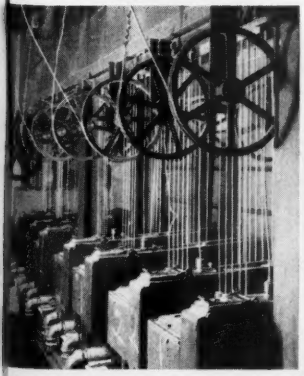
LETOFF STAND



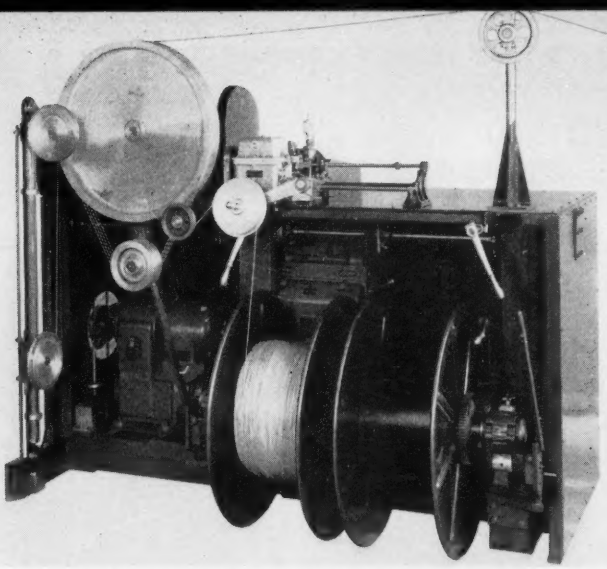
TUBING TAKEUP



LACQUERING SYSTEM



LACQUERING SYSTEM



CONTINUOUS TAKEUP WITH INTEGRAL CAPSTAN

INSULATED WIRE MACHINERY

EXTRUSION SYSTEMS

CONTINUOUS TAKEUPS — **CORD PRE-DRYERS**

LACQUERING SYSTEMS — **ENAMELING MACHINES**

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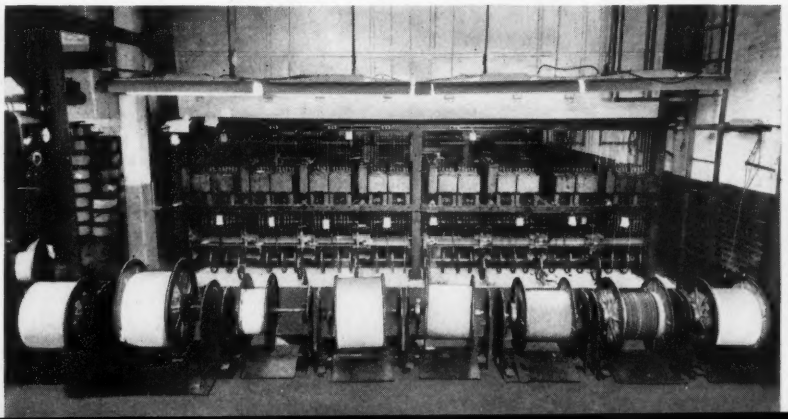
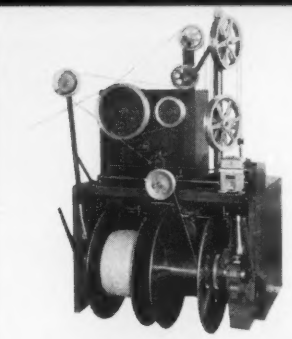
COOLING TROUGH

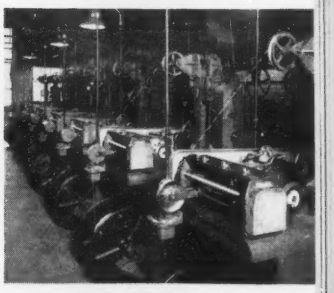
COOLING TROUGH

CABLE LACQUERING SYSTEM

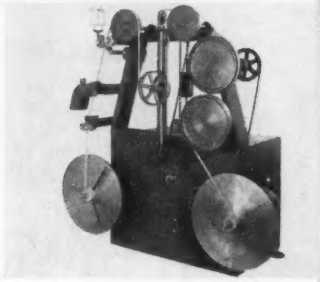




DUAL REEL TAKEUP



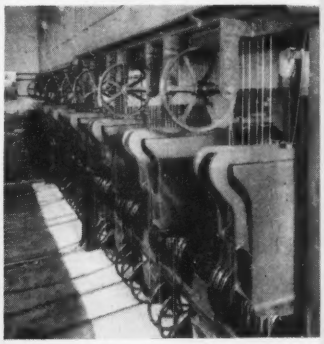
SINGLE REEL TAKEUP



STRIP TAKEUP

PAYOFF STANDS

WIRE PRE-ANNEALER



LACQUERING SYSTEM

Important News:

Annealing furnace for treating welded alloy tubing, installed at the plant of the Metal Forming Corp., Elkhart, Ind. INCONEL *tubing shown is 5-9/16 in. with 1/4 in. wall. The furnace operates continuously, 24 hours a day, 7 days a week. A hydrogen-nitrogen atmosphere is used. Temperatures range 1450° to 2000° F., and from these* INCONEL *tubes, the Metal Forming Corp. has received over 11,000 hours of service life.*

EXTRUDED INCONEL TUBES

The sizes of tubes listed below are those which can be produced from tools regularly carried in stock. Other sizes of extruded tubes can be produced on individual order.

O.D.	Wall	Maximum Length
2-1/2"	5/16"	11' 3"
3-1/4"	1/4"	—
3-1/4"	5/16"	17'
3-1/4"	3/8"	14' 3"
3-1/4"	1/2"	12' 6"
4"	1/4"	22'
4"	5/16"	18'
4"	3/8"	15' 3"
4"	7/16"	13' 3"
4"	1/2"	11' 9"
4"	5/8"	8'
4-1/2"	3/8"	13' 3"
4-1/2"	1/2"	10' 3"
4-1/2"	9/16"	9' 3"
4-1/2"	5/8"	8' 6"
5"	1/4"	—
5-9/16"	1/4"	—
5-9/16"	3/8"	14' 3"
5-9/16"	1/2"	11' 3"
5-9/16"	9/16"	10'
6"	1/4"	—
6"	3/8"	12' 6"
6"	1/2"	10'
6"	5/8"	8' 6"
6-1/2"	1/4"	—
6-1/2"	3/8"	11' 3"
6-1/2"	1/2"	8' 6"
6-1/2"	5/8"	7' 3"
7"	1/4"	—
7"	3/8"	10' 3"
7"	1/2"	8'
7"	5/8"	6' 6"
7-1/2"	1/2"	9' 9"
7-1/2"	5/8"	6'
8"	3/8"	11' 9"
8"	1/2"	9'
8"	5/8"	7' 6"
8-1/2"	3/8"	—
8-1/2"	1/2"	—
8-1/2"	5/8"	6' 9"
9-1/4"	7/16"	—
9-1/4"	1/2"	—
9-1/4"	5/8"	—

NOW you can have all the special advantages of INCONEL* *plus* the advantages of seamless, cold-drawn tubing . . . for large as well as small installations.

Here's why!

INCONEL—the heat-resistant, corrosion-and-oxidation resistant INCO Nickel Alloy—is now being extruded in tubing with outside diameters of all the way from 2½ to 9¼ inches. Wall thicknesses range from ¼ to ⅝ inches.

Just glance at the table. With such a variety of sizes at your command, you can meet almost any furnace design requirement. Remember, too, that special lengths and dimensions can often be produced to fit specific conditions. You can get INCONEL in standard mill forms, as well as tubing.

Whenever you need a metal to withstand extreme heat, oxidation, corrosion, destructive atmospheres . . . investigate INCONEL. You will discover why this unusual INCO Nickel Alloy is making performance history in the heat-treating field.

Send for your copy of: *"Inco Nickel Alloys for Long Life in Heat Treating Equipment."*

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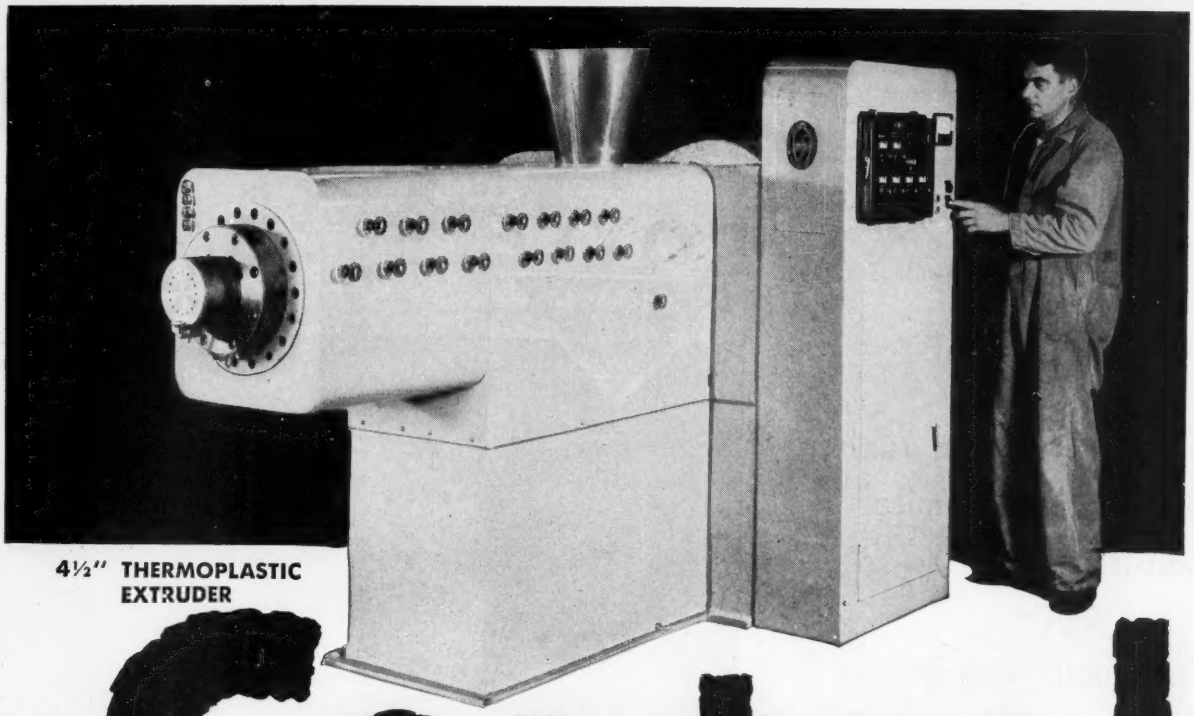
INCONEL*—FOR LONG SERVICE AT HIGH TEMPERATURES

(80 NICKEL - 14 CHROMIUM)

*Reg. U. S. Pat. Off.



4½" THERMOPLASTIC EXTRUDER

Control

Gives up to 25% less Scrap per pound!

Control

Control

Control

Control

. . . OF TEMPERATURE — Multiple electrically heated zones control material temperatures all along the cylinder. 6 Pyrometers give exact readings at any point along the way. *Accurate temperature control yields more saleable goods per pound.*

. . . OF COOLING — 9-11 or 15 cooling zones, each individually controlled, cool the entire working surface in a matter of minutes. This greater flexibility allows for quicker material switchovers. *Cooling time saved means greater profits.*

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. . . OF VOLTAGE — A screw speed indicator reveals the R.P.M. of the screw. Detects fluctuation drops in voltage. *This is an exclusive feature of mpm.* There are safety factors, too, to prevent breakage from overload. All instruments are rubber mounted for longer life.

If ever a machine was built for work — these extruders will stand the gaff day in and day out — around the clock.

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Extruders for the rubber, plastics and chemical industries

Continuous Vulcanizing Machines for rubber insulated wire

Plastic Insulated Wire Machines

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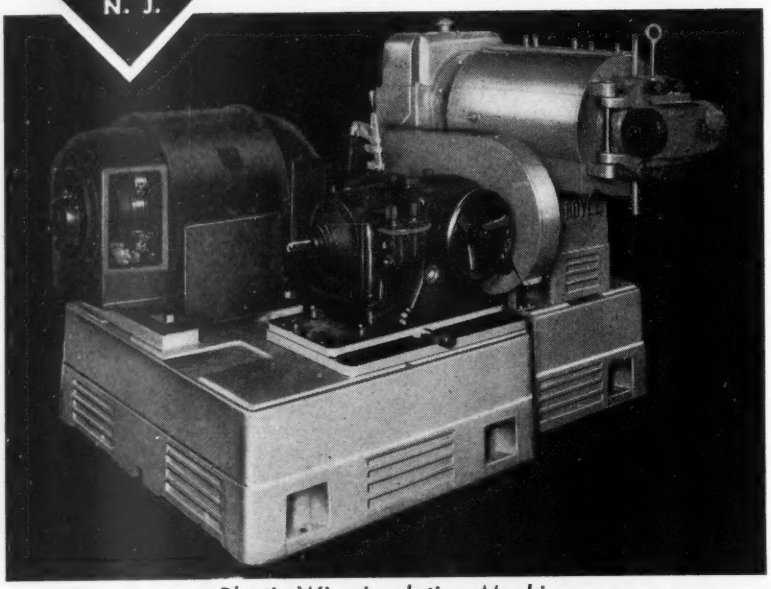
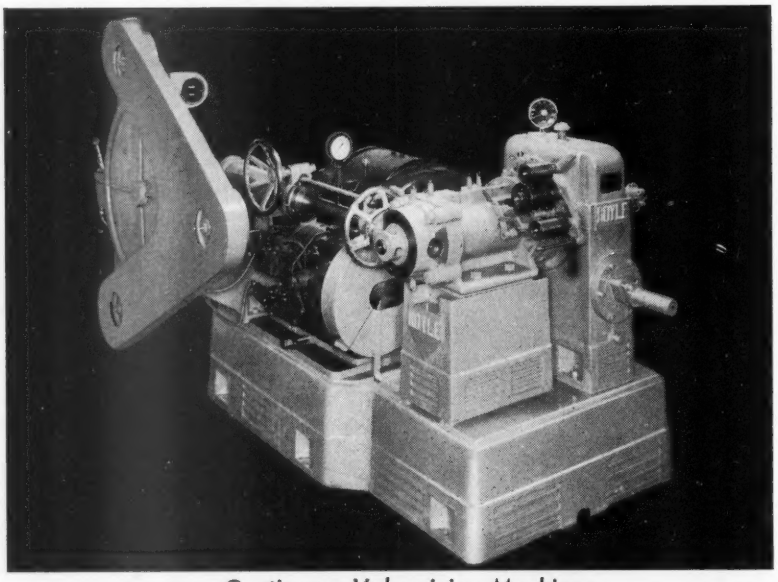
Temperature Control Units



Plastic Wire Insulating Machine



Continuous Vulcanizing Machine

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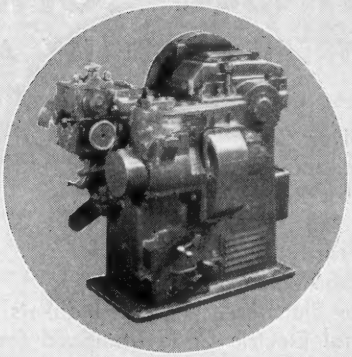

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BARE TINSEL CONDUCTORS

TO GIVE EXTREME FLEXIBILITY AND LONG LIFE

in

(1) Telephone Receiver Cords
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(6) Radio Loudspeaker Voice Coil Leads
(7) Leadin Wires for Electrically Heated Blankets, Clothing, etc.
(8) To meet National Electric Code Standard for Flexible Tinsel Cords.

Wound on reels ready for insulating with plastic, rubber, etc.

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IMPROVE QUALITY

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- Gives excellent adherence, uniform coverage, semi-lustrous finish
- Possesses high conductivity
- Permits use of high current densities

ADVANTAGES

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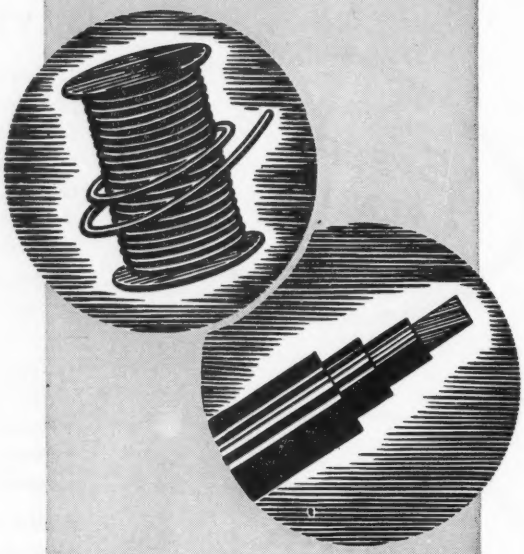
RESEARCH EXPERIENCE
In Insulating Wire Finishes



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Every formulation is engineered to individual specifications for the particular service required.

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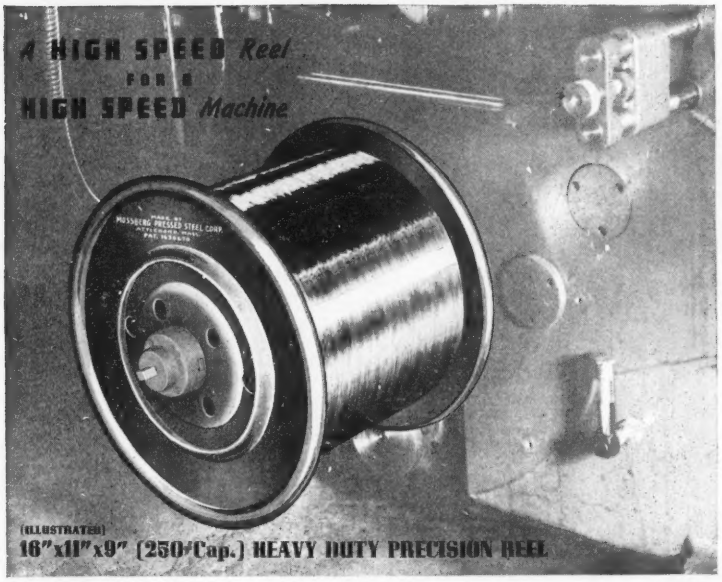

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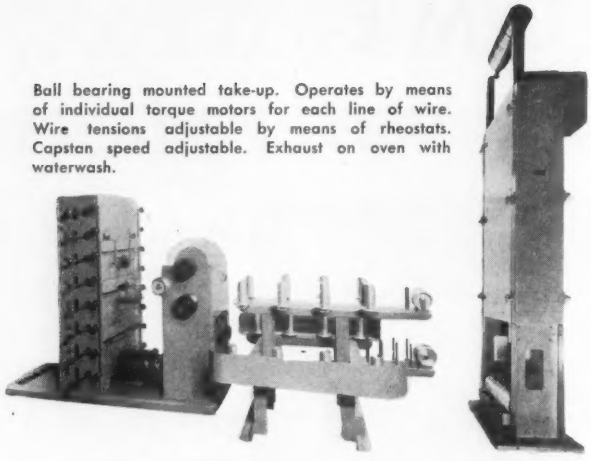
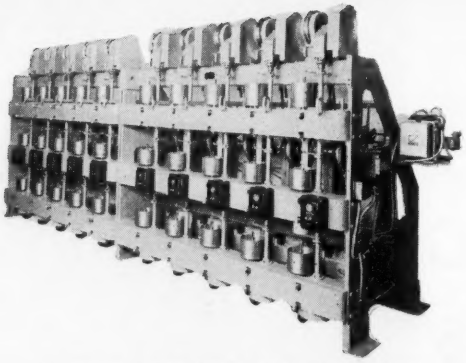


S-16 MEDIUM WIRE ENAMELING MACHINE #919



MODEL 2T10-MBB MACHINE #921

Applies A Triple Cover of Insulation at High Speed; ball bearing, each unit individually motor driven; for application of all types of insulation spirally wound.

EST. 1855 AIMco INC. 1915

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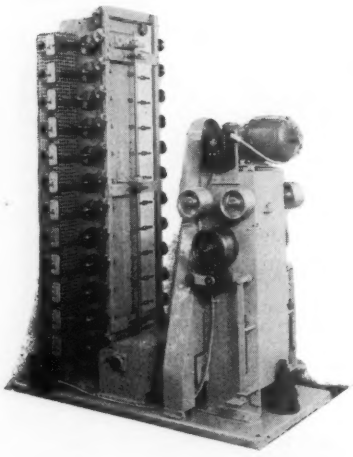
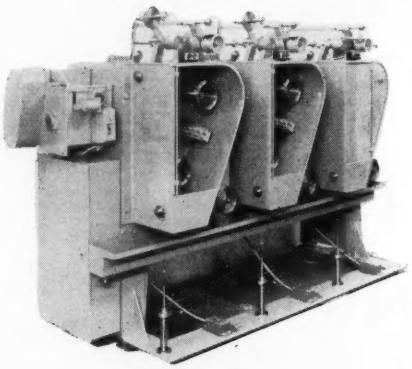


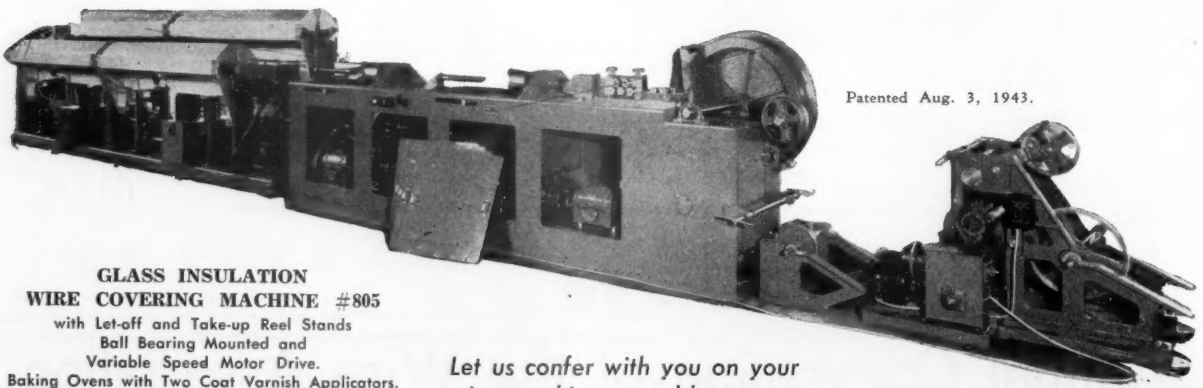
24 Unit VERTICAL PULLOUT #923

For Annealing Processes etc., ball bearing mounted, equipped with capstans and speed variator. Spool spindles driven by individual torque motors each adjustable for winding tension by means of a separate rheostat.



3 UNIT FINE WIRE DRAWING MACHINE #932

with units individually motor driven, ball bearing mounted throughout, welded frames.



Patented Aug. 3, 1943.

GLASS INSULATION WIRE COVERING MACHINE #805

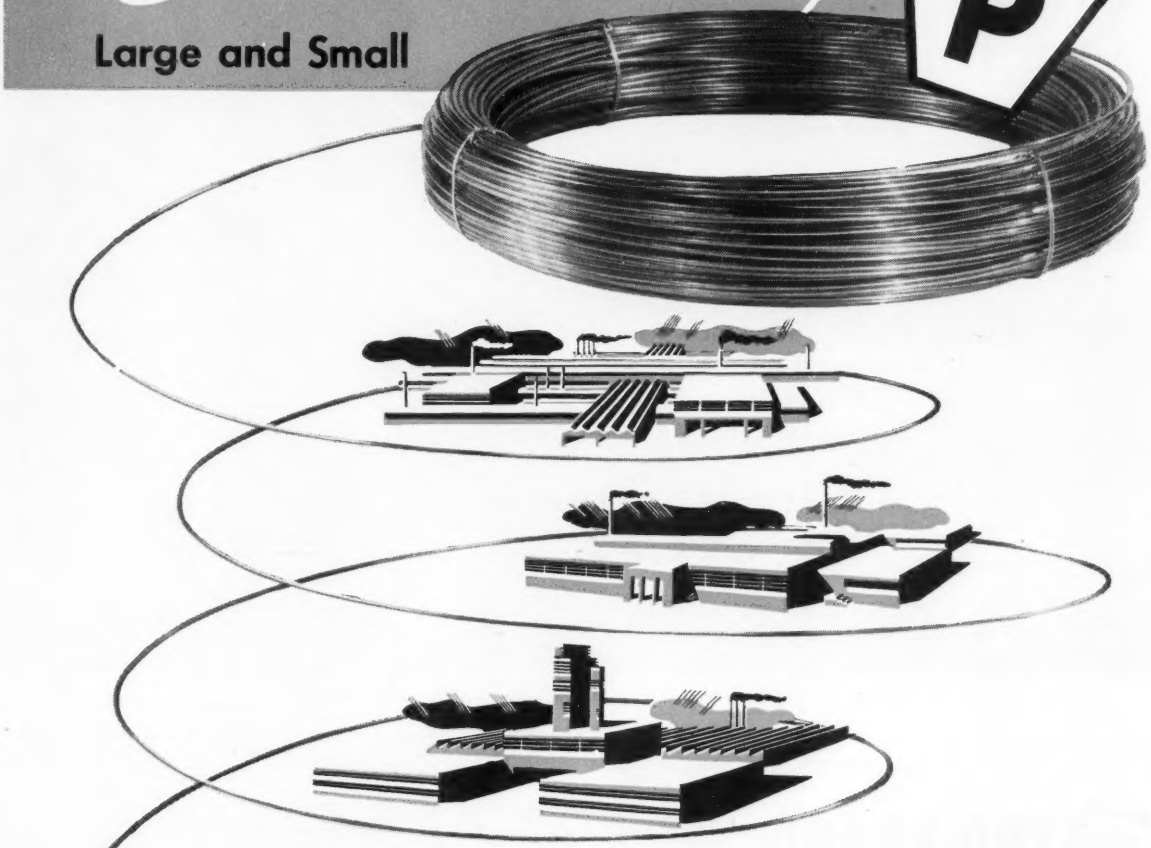
with Let-off and Take-up Reel Stands
Ball Bearing Mounted and
Variable Speed Motor Drive.
Baking Ovens with Two Coat Varnish Applicators, and Individual Automatic Temperature Controllers.

Let us confer with you on your wire machinery problems

Pittsburgh Steel Wire

Serves all Industry

Large and Small



Carbon, Alloy and Stainless Steel Wire—All Grades

Accurate, uniform wire for all industry has long been the standard at Pittsburgh Steel Company. Skilled workmen, modern machines and methods are striving constantly to better these standards to help you produce wire products with greater ease and economy.

Pittsburgh Steel Company

3269 Grant Building, Pittsburgh 30, Pa.

JOHNSON STEEL & WIRE COMPANY, INC.

Worcester, Mass.

Fluffy as Goose Feathers

Slippery as an eel

AERO-BRAND Quality STEARATES

AERO® BRAND STEARATES are light, fluffy, pure . . . to make some products as *slippery* as possible with minimum lubricant . . . to impart *smoothness* to others . . . to *reduce friction* in still others.

Uniform quality?

You bet! And for both large and small orders.

For Cyanamid's production, (most modern facilities of their kind, incidentally), is rigidly controlled every step of the way—from the acid . . . to final quality stearate.

We're ready to be your *dependable* source of supply. Just be sure to specify AERO BRAND on your Calcium . . . Zinc . . . Aluminum . . . Magnesium stearate orders.

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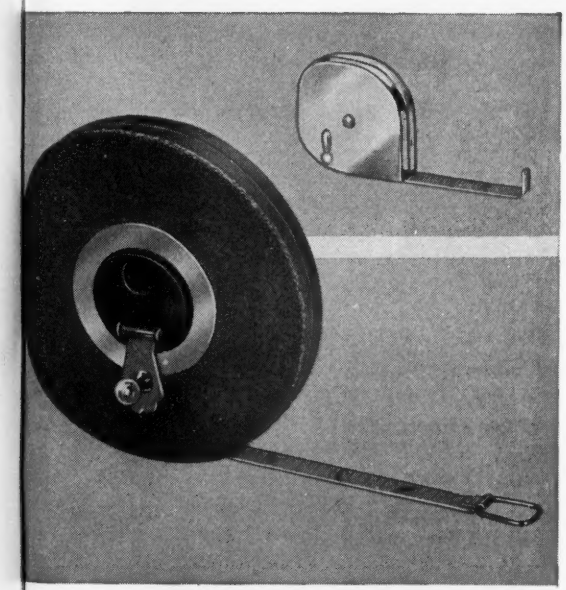
SALES OFFICES: Boston, Massachusetts; Philadelphia, Pennsylvania; Pittsburgh, Pennsylvania; Baltimore, Maryland; Charlotte, North Carolina; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Illinois; Detroit, Michigan; Kalamazoo, Michigan; St. Louis, Missouri; Los Angeles, California; San Francisco, California; Seattle, Washington.

American
Cyanamid Company

Industrial Chemicals Division

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Confidence- WITH ITS SLEEVES ROLLED UP!



STRAIGHT AND STALWART, every factory stack is a towering symbol of man's faith in the future... industry's confidence in its ability to create and to expand production for better living and a richer world.

With confidence like that, Roebling has pioneered in developing and making an extraordinary range of products indispensable to industry. And the confidence that its products and engineering skill have earned in every industrial field is one of Roebling's most valued assets. Every Roebling employee is striving to safeguard that confidence by making products and rendering services that are of maximum utility to you.

MEASURE THIS FLAT WIRE BY ANY STANDARD

SIZE UP ROEBLING FLAT WIRE... its steel analysis, dimensional uniformity, temper, finish. You'll find it's *right* on every count . . . meets specifications and helps beat mounting production costs.

Roebling looks out for you by controlling each step in the manufacture of its flat wire . . . makes its own steel to assure the right metal composition . . . produces wire by means of modern, highly specialized equipment and techniques . . . constantly applies the results of research and development to give you the finest flat wire that can be made.

Specify Roebling Flat Wire with confidence that it will meet your requirements. Your Roebling Field man will help you determine the *right* wire for the job, and the right way of handling it. Write or call your nearest Roebling branch office.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

A CENTURY OF CONFIDENCE

ROEBLING

JAR ROEBLING

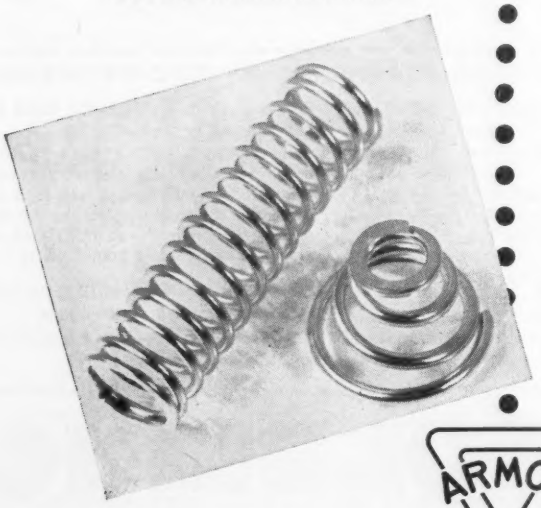
★ *WIRE ROPE AND STRAND* ★ *FITTINGS* ★ *SLINGS* ★ *SUSPENSION BRIDGES AND CABLES* ★ *AIRCORD, AIRCORD TERMINALS AND AIR CONTROLS* ★ *AERIAL WIRE ROPE SYSTEMS* ★ *ELECTRICAL WIRE AND CABLE* ★ *SKI LIFTS* ★ *HARD, ANNEALED OR TEMPERED HIGH AND LOW CARBON FINE AND SPECIALTY WIRE, FLAT WIRE, COLD ROLLED STRIP AND COLD ROLLED SPRING STEEL* ★ *SCREEN, HARDWARE AND INDUSTRIAL WIRE CLOTH* ★ *LAWN MOWERS*

you get 8 big advantages

with this new spring wire

What it gives your products

High Elastic Properties
High Tensile Strength
High Torsional Strength
High Fatigue Resistance
Low Deflection
Low Permanent Set
Low Elastic Drift
Good Corrosion Resistance



Springs made of ARMCO 16-2 Spring Temper Wire.

If you can use Stainless Steel spring wire to advantage you'll want to know about the many excellent properties of ARMCO 16-2 Spring Temper Wire.

Special mill processing gives this new spring wire exceptionally high elastic properties and low drift. Its elasticity is indicated by these data:

Wire Diameter, Inch	Proportional Limit in Tension 1000 psi
.0365	264
.060	206
.291	170

Low Permanent Set

Another outstanding characteristic of ARMCO 16-2 Spring Temper Wire is its low permanent set at elevated temperatures. How well this special wire maintains load-carrying properties at elevated temperatures is revealed in these comparative tables:

Stress 40,000 psi	Temperature 650° F.	
Material	Permanent Set After 812 Hours	Permanent Set After 600 More Hours
Music Wire	40.0%	No Data
18-8 Stainless Steel	14.0	19.0%
ARMCO 16-2	6.4	6.4

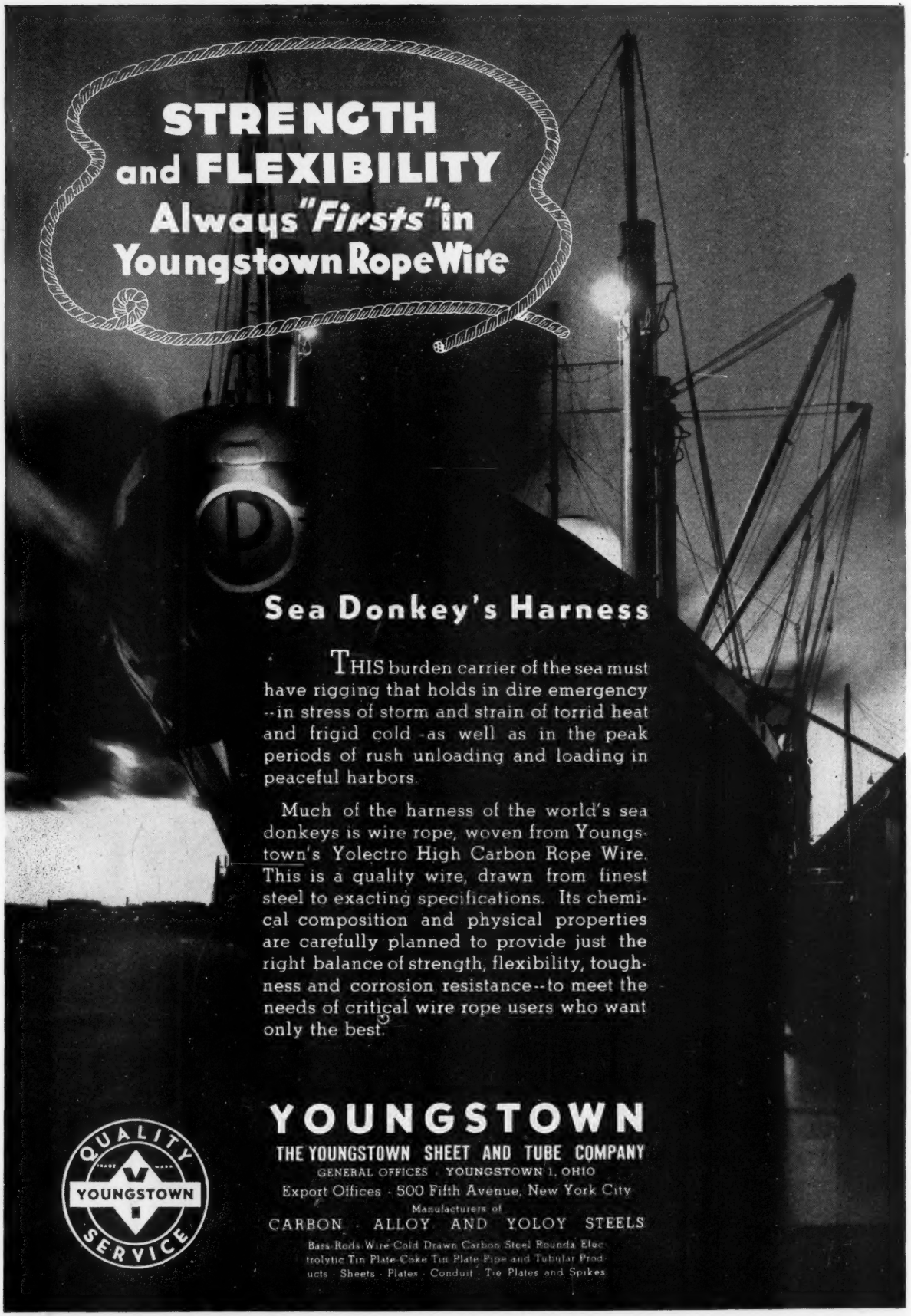
ARMCO 16-2 Spring Temper Wire is supplied in coils or straight lengths, with a standard cold-drawn finish or with a lead coat for use on automatic coiling machines. Write to the address listed below for your free copy of the descriptive booklet "This New Spring Wire Gives Your Products 8 Big Advantages."

Other ARMCO Stainless Steels available for early delivery include a wide variety of sheets, strip, plates, bars and wire. Just address Armco Steel Corporation, 490 Curtis Street, Middletown, Ohio.

Export: The Armco International Corporation.

ARMCO

ARMCO Stainless Steel Wire


STRENGTH
and FLEXIBILITY
Always "Firsts" in
Youngstown RopeWire
Sea Donkey's Harness
THIS burden carrier of the sea must have rigging that holds in dire emergency --in stress of storm and strain of torrid heat and frigid cold -as well as in the peak periods of rush unloading and loading in peaceful harbors.
Much of the harness of the world's sea donkeys is wire rope, woven from Youngstown's Yolectro High Carbon Rope Wire. This is a quality wire, drawn from finest steel to exacting specifications. Its chemical composition and physical properties are carefully planned to provide just the right balance of strength, flexibility, toughness and corrosion resistance--to meet the needs of critical wire rope users who want only the best.
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Manufacturers of
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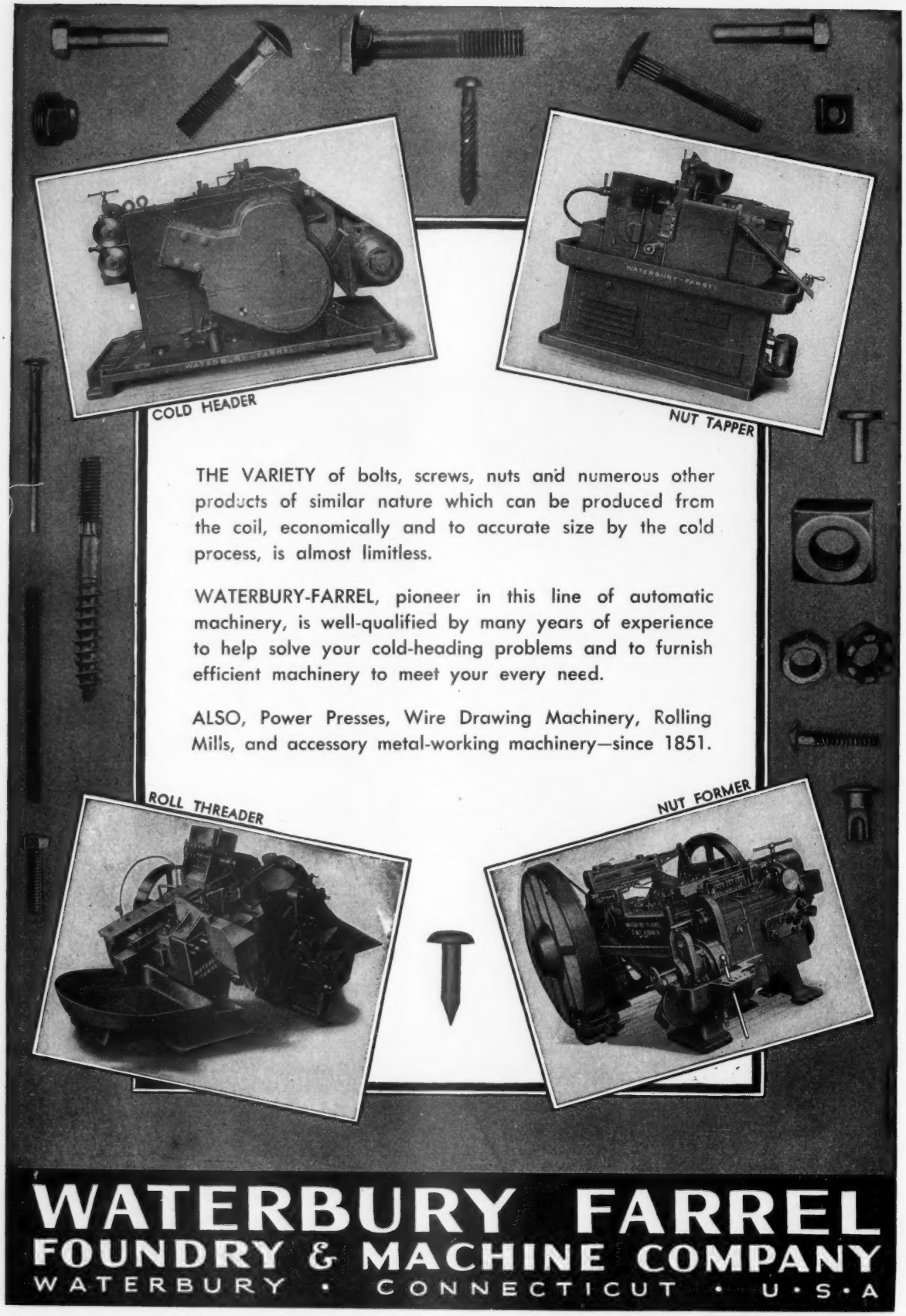
Bars · Rods · Wire · Cold Drawn Carbon Steel Rounds · Electrolytic Tin Plate · Coke Tin Plate · Pipe and Tubular Products · Sheets · Plates · Conduit · Tie Plates and Spikes



THE VARIETY of bolts, screws, nuts and numerous other products of similar nature which can be produced from the coil, economically and to accurate size by the cold process, is almost limitless.

WATERBURY-FARREL, pioneer in this line of automatic machinery, is well-qualified by many years of experience to help solve your cold-heading problems and to furnish efficient machinery to meet your every need.

ALSO, Power Presses, Wire Drawing Machinery, Rolling Mills, and accessory metal-working machinery—since 1851.

WATERBURY FARREL
FOUNDRY & MACHINE COMPANY
WATERBURY • CONNECTICUT • U·S·A

'Surface'

STANDARD AND SPECIAL

INDUSTRIAL FURNACES

MALLEABLEIZING
SURFACE COMBUSTION FURNACES
Surface Combustion PRODUCTION FORGE FURNACES
SURFACE COMBUSTION FURNACES in the STEEL WIRE INDUSTRY
HEATING AND HEAT TREATMENT OF COPPER AND BRASS
MODERN GAS CARBURIZING
ANNEALING AND NORMALIZING IN SURFACE COMBUSTION FURNACES
'Surface' PREPARED GAS ATMOSPHERES
DRY CYANIDING
TOOL ROOM Flexibility

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For many years 'Surface' has shared with the metal producing and heat treating branches of industry pertinent information on the various processes that its engineers encounter in their field work and in the experimental operations carried on by the research and development divisions of Surface Combustion Corporation.

A continuing program of technical publications brings this helpful information to you for immediate use or future reference. The bulletins, catalogs, reprints, etc., listed below are available upon request.

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Tempering (Standard Rated Furnaces)	SC-133
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Timken-Detroit Axle Company installs Modern Heat Treating Equipment
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See Us at the
NATIONAL METAL EXPOSITION
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October 25-29

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

THIS WISSCO WIRE *Speeds Power* AROUND CURVES

General Construction of Stow Flexible Shaft Core

The facility with which the Stow Flexible Shaft operates around curves lends itself to a wide variety of applications involving transmission of power.

Because the strength and easy operation of the flexible shaft is dependent upon its core, the Stow Manufacturing Co. has established exacting standards for the wire used in core construction. The Wissco Shaft Wire used in Stow Flexible Shafts is a high carbon or low carbon, hard drawn, bright or liquor finish wire, designed to meet the manufacturer's rigid specifications for uniformity in size, tensile and stiffness.

Wissco Shaft Wire is but one of the many Wickwire Spencer specialty wires. Our 126 year experience, plus the fact that we operate our own open hearth furnaces and modern wire mills, enables us to supply anything you need in steel specialty wires, high or low carbon; round or shaped; in a wide variety of sizes, tempers, grades and finishes.

Wickwire Spencer metallurgists are ready to help solve your wire problems—to develop wire that best meets your particular requirements. Send your order or inquiry to Wickwire Spencer.

WISSCO *Wire*

A PRODUCT OF WICKWIRE SPENCER STEEL DIVISION · THE COLORADO FUEL AND IRON CORPORATION

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PACIFIC COAST SUBSIDIARY—THE CALIFORNIA WIRE CLOTH CORP., OAKLAND 6, CAL.

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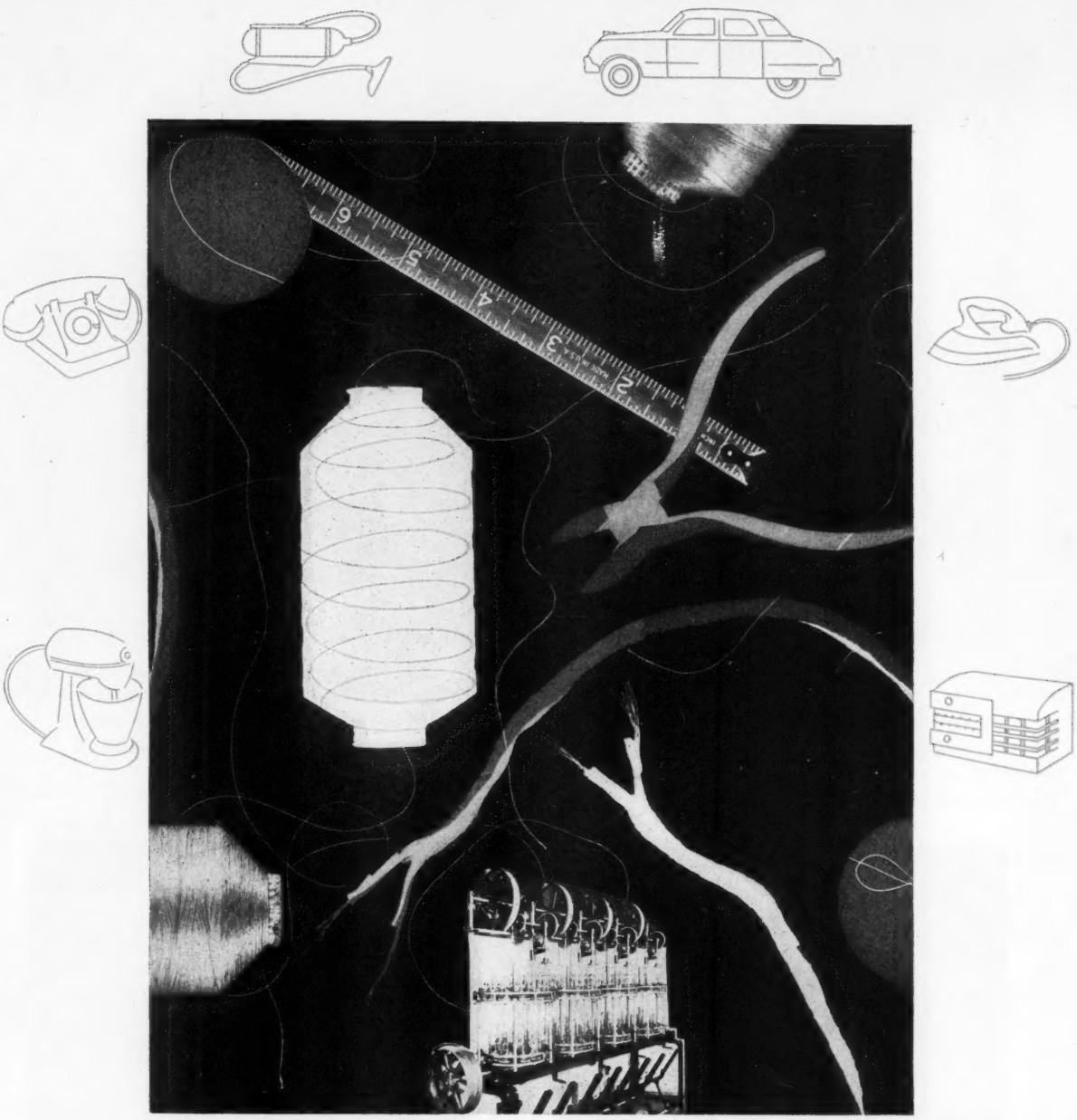


How **STRONG** should insulated yarn be?

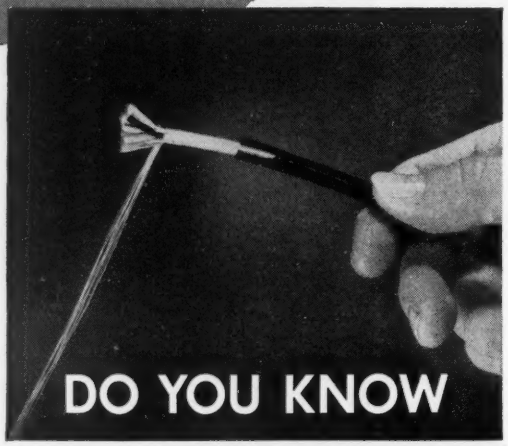
Strong enough to carry the load . . . and that's the story of Warren thread. Famous thread and yarn manufacturers since 1864. Warren is prepared to meet your specific needs in any size or put-up, single or multiple wound, glazed, soft, or special finishes.

W. WARREN
THREAD WORKS, INC.

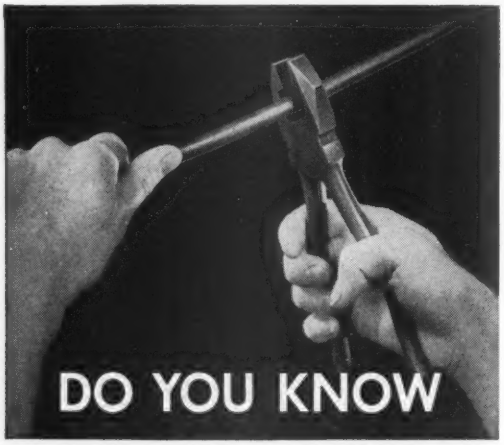
72 Leonard Street, New York 13, N. Y.
Mills: Westfield, Mass.

FIBERGLAS* 150's YARNS are VERSATILE

...that FIBERGLAS* 150's Yarns provide Nonmetallic-Sheathed Building Cables with a *High-Strength, Low-Cost Ripcord?*



...that braiding or serving costs are lower and efficiency improved *(fewer yarn breaks—fewer package changes)* when you use Fiberglas 150's yarns for separator wraps or braids on flexible cords? In addition, the quality of the cord is improved *(increased flex life)*.



...THAT FIBERGLAS* 150's YARNS USED FOR OUTER BRAIDS OF NONMETALLIC-SHEATHED BUILDING CABLES OFFER:

- Low Material Cost of Braid
- Fewer Yarn Package Changes ... Less Braider Down Time
- Fewer Yarn Breaks ... Improved Braiding Efficiency
- Lower Cable Shipping Costs ... Lighter Weight

... WHY FIBERGLAS* 150's YARNS ARE BEING USED FOR CABLE TENSION MEMBERS?

Answer: They provide low cost ...per unit length of yarn ...per pound of tensile strength with minimum space occupancy

● For complete information about Fiberglas Yarns for these, and other electrical uses, write Owens-Corning Fiberglas Corporation, Dept. 875, Toledo 1, Ohio. Branches in principal cities.
In Canada: Fiberglas Canada Ltd., Toronto 1, Ontario.

OWENS-CORNING FIBERGLAS Yarns

TM. REG. U.S. PAT. OFF.

***Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) for a variety of products made of or with glass fibers by Owens-Corning Fiberglas Corporation.**

Product-Proved Wire . . .

PREFERRED BY

HUNDREDS OF MANUFACTURERS

CONTINENTAL STEEL CORP. STEEL CONTINENTAL REG. U.S. PAT. OFF. WIRE KOKOMO, IND.

Whether the need is for a rust-resistant wire that can stand up under difficult forming operations, or . . . for a shaped wire to provide a better-looking, longer-lasting trim for a particular product . . . manufacturers turn with confidence to Continental. More and more, manufacturers are depending on Continental wire to help them build better products. They know Continental wire is uniform in temper, uniform in coating, and that it is made to fit specific manufacturing and fabricating requirements.

Continental Chain Link Fence is used to enclose the properties of hundreds of industrial plants. It is the only fence made of KONIK, a patented steel containing copper, nickel and chromium to provide "clear through" resistance to rust and corrosion. When you need fencing for your property, insist on Continental Chain Link Fence. It will provide longer-lasting protection at lower cost per year of fence life. For further information write Continental at Kokomo, Indiana.

CONTINENTAL STEEL CORPORATION

GENERAL OFFICES • KOKOMO, INDIANA

PRODUCERS OF *Manufacturer's Wire* in many sizes, shapes, tempers and finishes, including Galvanized, KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, Lead Coated, and special wire. ALSO, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.

MACHINERY FOR HIGH SPEED PRODUCTION OF CABLES, STRANDS AND INSULATION

BUTT Wire Working Equipment is backed by many years of experience in the designing and building of machinery for the Wire Industry. Fast and dependable, BUTT Machines are ideal for maintaining product quality, boosting output, reducing maintenance, and building profits.

BRAIDERS

Types for all purposes in sizes up to 64-carrier. (Circulars Nos. 28, 90, and 91)

CABLE CLOSING MACHINES

Various sizes up to 60" diam. reel for 3, 4, 7, and 8 strands. (Circular No. 80)

VERTICAL PLANETARY CABLERS

Five sizes, from 3 to 6 spools. (Circular No. 71)

CAPSTAN TAKE-UP UNITS

Machines for any number and size of reels. (Circular No. 79)

MOTORIZED TAKE-UPS

Machines can be made for any number and size of reels. (Circulars Nos. 78, 79, and 92)

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Two sizes — for bunching wires up to # 14 B. & S. gage and strands up to # 8 B. & S. gage. (Circular No. 63)

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Three sizes — 100, 300, and 500 lb. spools, 6 to 30 reels. (Circular No. 70)

PLANETARY STRANDERS

Sizes for 100, 250, and 500 lb. spools, for combinations of stranded wire from 7 to 91 ends. (Circular No. 84)

HIGH SPEED STRANDERS

Capacities from 7 to 41 reels. (Circular No. 73)

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Horizontal, Eccentric, and Concentric types, single or multiple heads. (Circulars Nos. 77, 81, and 83)

Ask for illustrated Circulars as listed above.

NEW ENGLAND BUTT COMPANY

Established 1842

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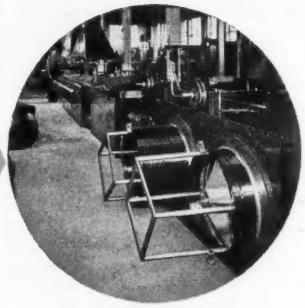
JAMES DAY (MACHINERY) LTD., "FORD HOUSE", 88 REGENT ST., LONDON, W. 1, ENGLAND

THE *Trauwood* PROCESS IS SETTING A NEW "WIREBOUND" TRADITION!!

QUALITY, UNIFORMITY, LOW-COST OPERATION

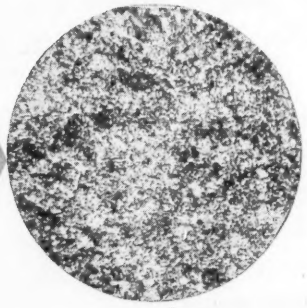
★ The electric resistance heating used in our process is over 90% efficient and results in a uniformly heat treated product plus the ability to duplicate exact heating and quenching cycles from day to day. Positive circulation in the molten metal quench bath insure absolute uniformity of the wire.

FASTER PRODUCTION FULLY AUTOMATIC



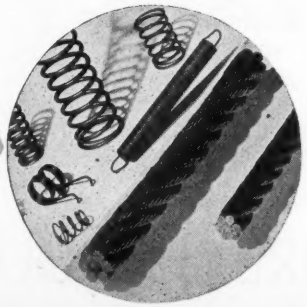
★ The TRAUWOOD process is much faster than ordinary furnace heating due to the very rapid rate of electric resistance heating. The equipment is entirely automatic and is easy to operate. Greater production with a material reduction in pickling and cleaning costs is insured.

BROAD THERMAL RANGE ACCURATE CONTROL



★ The finer grain produced by TRAUWOOD electric resistance heating develops the maximum physical and fatigue properties in any steel in either patenting, tempering or annealing. The annealing of stainless steel and other alloy wire and strip is readily accomplished since the high quenching temperatures necessary are easily and rapidly attained.

CAN BE DESIGNED FOR ALL SIZES AND TONNAGES



★ The TRAUWOOD process, in addition to doing a better wire heat treating job, is opening new fields of application for the wire industry. The equipment is designed to meet your specific requirements and can be built to handle all sizes in any tonnage required. Full information will be furnished on request.

Patented in U.S.A. and Foreign Countries

THE TRAUWOOD ENGINEERING COMPANY

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JOHN RIGBY & SONS, LTD., LOW MOO R, BRADFORD - YORKS, ENGLAND

British Representatives

A Message to Those Who Serve the WIRE INDUSTRY

Particularly directed to those concerns who are not now advertising.

If you manufacture wire for wire product fabrication or make machinery or supplies used in the wire industry, WIRE AND WIRE PRODUCTS is your primary advertising medium.

The publication not only covers the domestic field with great thoroughness, but goes to the principal wire and wire consuming firms in twenty foreign countries.

Are you holding off because you have a husky back-log of unfilled orders? The time to advertise to get your name out in front of the field as a responsible source of supply is NOW. Later on, when the competition becomes tough, may be too late. What you should do today, cannot be done as effectively tomorrow. We urge you, in the name of good, continuing business, to make your plans to promote your business, while BUSINESS IS GOOD.

You can keep the cost of ad preparation down by having a series of three ads that can be rotated. It saves money and time and experience has proven that an advertising series run on this basis will be as effective as a new ad every month.

Plan to start your advertising in 1949.

If you do not have rates and particulars, write today to

WIRE AND WIRE PRODUCTS

EDMUND D. SICKELS, Advertising Manager

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Telephone: STAMFORD 3-0482

LOW CARBON WIRE
(Bright, Galvanized and Coppered)

OIL TEMPERED AND UNTEMPERED M.B. SPRING WIRE

TIRE BEAD AND ROPE WIRE
(All Grades and Finishes)

FINE AND WEAVING WIRE

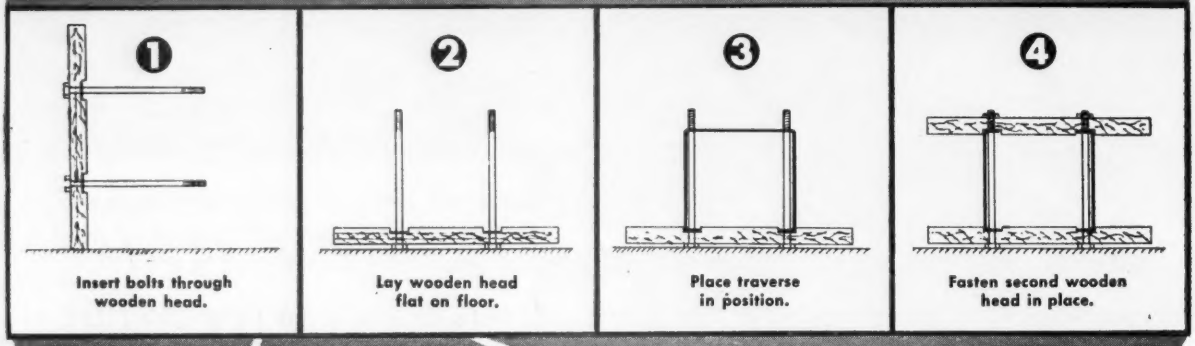
LOW AND HIGH CARBON SPECIALTY WIRES

"Portsmouth" — *a new name in wire,* but already winning enthusiastic support from users of all types of low carbon and special analysis high carbon wire. Portsmouth has years of wire making experience — it was the first rolling mill in the Northwest Territory. It employs the most modern methods in wiremaking — the result of an extensive modernization and expansion program. And it offers a completely integrated mill, with quality control from ore to finished product and careful attention to your individual specifications.

PORTSMOUTH STEEL CORPORATION

PORTSMOUTH, OHIO

Save Time • Labor • Space • Money through this simple 4-Step Assembly of STEVENS Flanged Steel Traverses



Stevens Flanged Steel Traverses save time . . . because they require only four simple steps in reel assembly. They save labor . . . no special tools are necessary. They may be stacked and stored in a minimum amount of room . . . thus saving space. And they save money by providing long service life. Actual experience records show that Stevens Flanged Steel Traverses have given as much as sixteen year's service—without refinishing or major maintenance. In many cases their use has doubled the number of trips per reel before cut downs or scrapping of wooden heads.

Stevens "Reinforced Type" Steel Traverses have *extra strength* where it is needed most—at bolt holes and base of flange. Reinforcing makes possible the use of lighter gauge steel, saving up to 20% in weight while increasing overall strength.

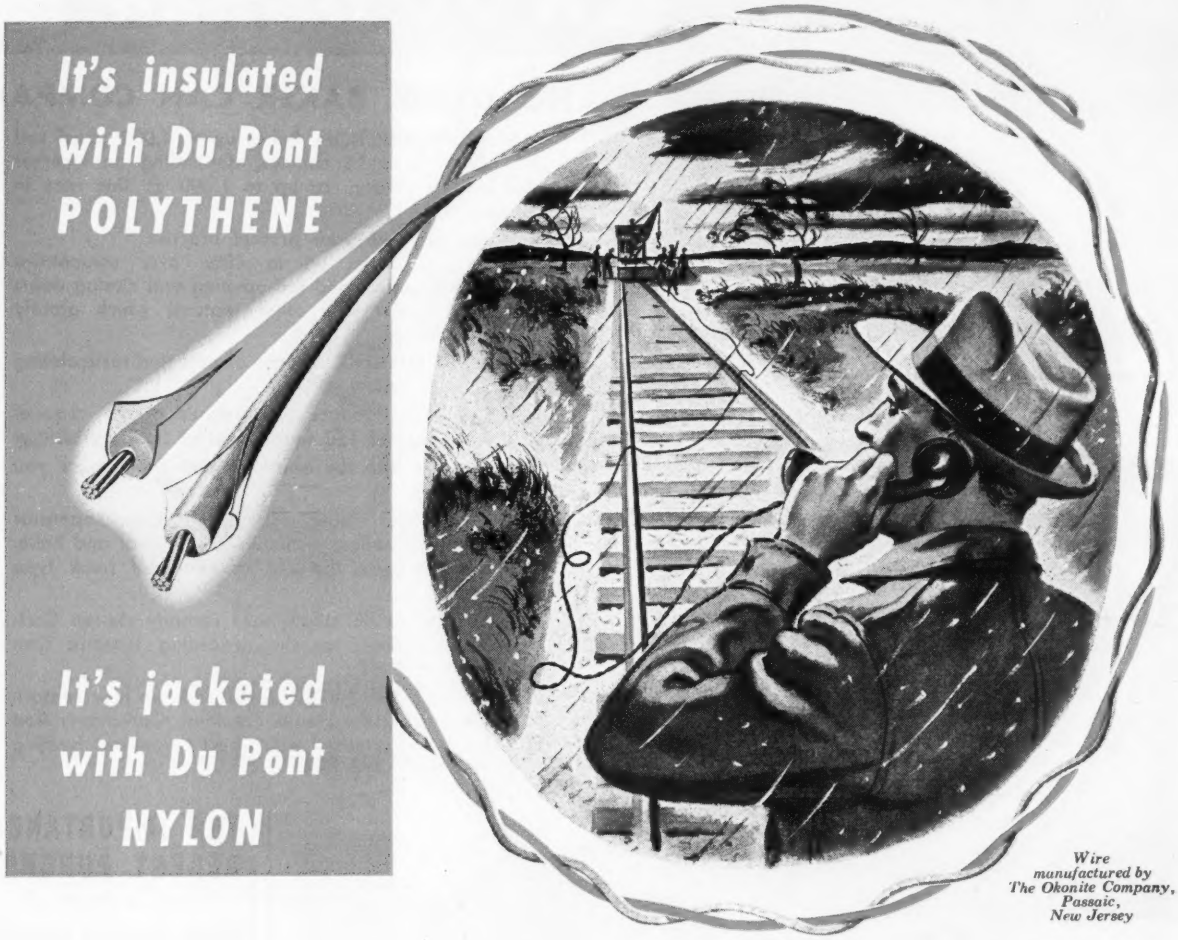
Sizes of Stevens Flanged Steel Traverses range up to 56" diameter and 48" traverse. Finishes include plain, painted and hot dip galvanized. Width of flange and number of bolt and drain holes can be furnished to your specifications. Write today for prices.

NILES STEEL PRODUCTS DIVISION
REPUBLIC STEEL CORPORATION
NILES, OHIO

REPUBLIC STEEL

STEVENS
FLANGED STEEL TRAVERSES

New emergency field wire has minimum diameter... maximum toughness



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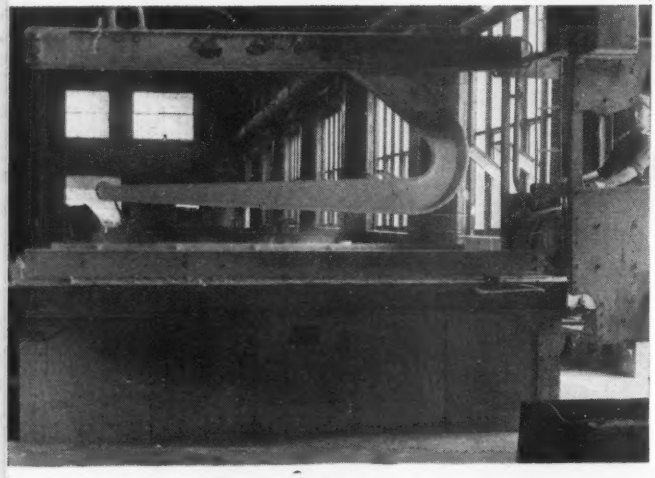

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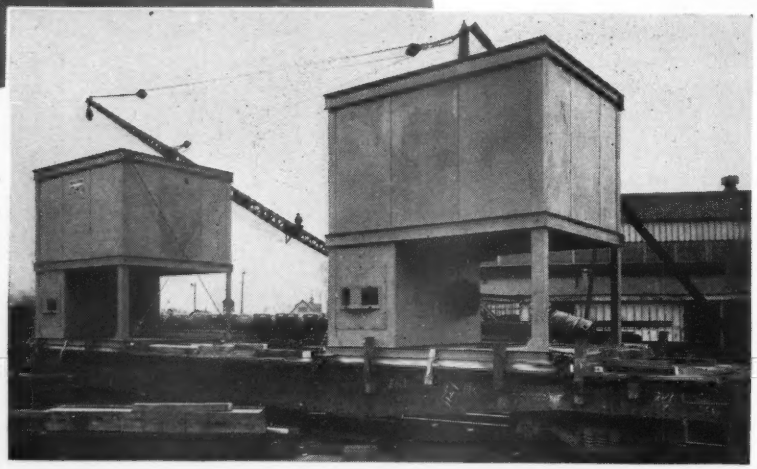

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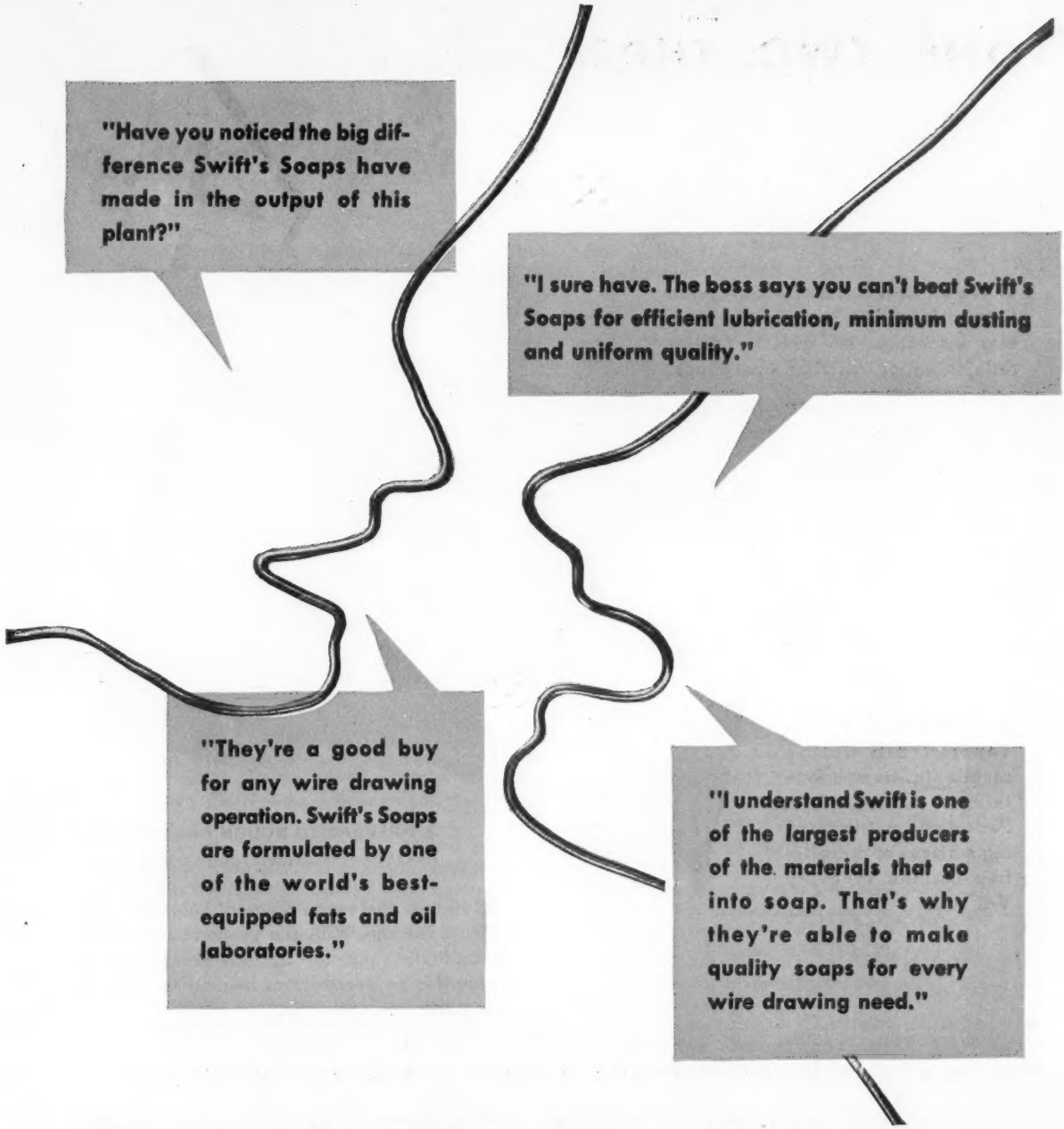
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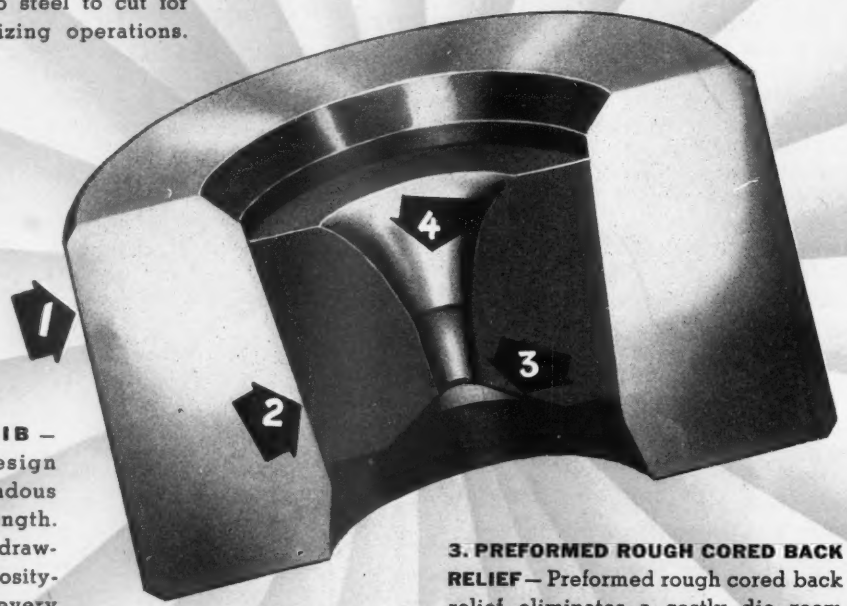

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The Wire Outlook

The decision of the Supreme Court that led to the substitution of F. O. B. quotations in place of the base pricing system is having serious repercussions in the wire industry as well as many others.

As has been much publicized, the effect of the decision, which applied the letter of the law and ignored its spirit and purpose, would be to create a series of highly monopolistic territories, in which, in the steel industry, mills serving a particular area would be the sole suppliers.

In the present sellers' market the effect is somewhat offset by the willingness of buyers to pay slight freight premiums to secure their rods and wire. Once we return to a buyers' market, where competition is keen and price is a vital consideration, a vast relocation of manufacturing industry and workers and a centralization of industry convenient to sources of supply would become an economic necessity, creating much needless expense and hardship.

While this could happen and may, it is to be hoped that the Congressional committee created to study the situation will be able to make recommendations that will provide the Congress with a basis for an Anti-Trust Law modification that will permit a return to the previous pricing system and thus avoid an economic and social upheaval.

While the scrap supply is better; that it is not adequate is evidenced in the meeting in Washington in September called by the Secretary of Commerce to secure better cooperation from scrap sources in getting this essential back to the steel mills.

Government stockpiling has begun in earnest, some 67 materials having been placed on the list of items essential to security, 30 of which are to receive immediate action. This latter group includes lead, tin, copper, zinc, tungsten, nickel, cadmium, vanadium, bauxite and industrial diamonds, all of considerable interest to the wire industry. During the stockpiling period, supplies to manufacturers are not expected to improve—rather, the reverse, with more voluntary allocations for all metals. It is not expected that the stockpiling will add significantly to the inflationary trend, however.

While wire prices have never been so complex and confusing, the demand for finished wire for most products is so great that there has been no noticeable consumer reaction. Nails, fencing and barbed wire, due to seasonal demands, are in very short supply, although poultry netting, lawn fence, welded fabric and bale ties appear to be readily available currently. Cold heading and fastener wire supply is considerably under demand, the rod shortage being responsible for the condition.

The iron and steel industry is increasing its total expenditures for modernization and expansion more than all other manufacturing industries combined. $565,000,000 will have been spent by the close of this year for new iron and steel facilities. Then why isn't more steel available? The reasons given are shortages in coke, pig iron and scrap, increasing difficulties in getting ore, and increasingly frequent mechanical breakdowns.

Aluminum, last year fairly plentiful, has been short this year and is likely to be in 1949. The tremendous growth in the demand for it, coupled with electric power deficiencies and Government stockpiling, has not made those who turned to aluminum for wire and wire products any happier.

It is heartening to observe that Department of Commerce reports show a tapering off of exports to the U. S. S. R. starting in May and becoming negligible after that. The wonder is that the State Department did not have the foresight to shut off these supplies long ago.

Business is expected to continue at high levels for the balance of the year. The weak spot is considered to be farm prices. They are expected to decline, but if too sharply, it is feared that the shock might be felt widely. Yet the Government will spend 6 to 7 billions in the next two years to support farm prices!

This month, October, is Convention time in wire circles. It will be our pleasure again to welcome those old friends and new who come to Pittsburgh to participate in the affairs of the Wire Association. We shall hope to see representatives of our widely diversified and scattered wire industry, from both home and abroad, on this occasion.

—from the Editor's Desk

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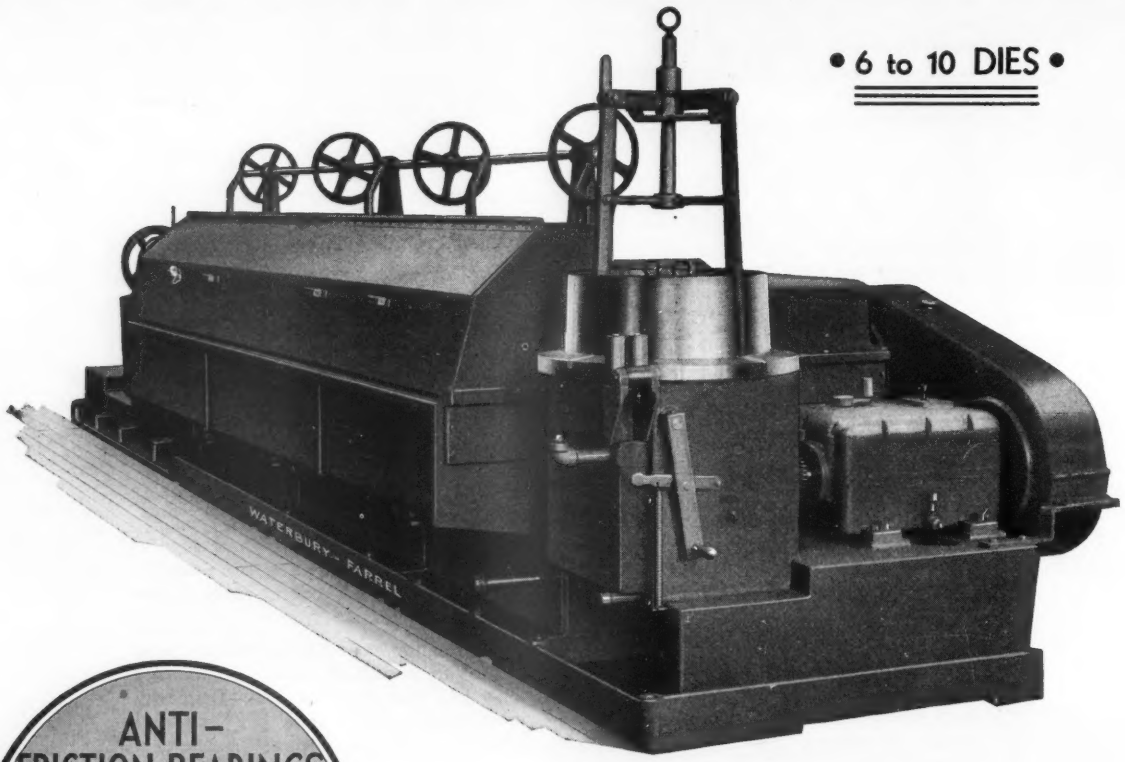

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 23 OCTOBER, 1948 No. 10

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 23 OCTOBER, 1948 No. 10

Formation and Properties of Martensite on the Surface of Wire Rope

By J. H. Corson, Research Engineer
John A. Roebling's Sons Co.,
Trenton, N. J.

A study of the effect of Martensite on the surface of wire rope. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

IN the early part of 1908, **Dr. H. C. Boynton** of the **John A. Roebling's Sons Company** was metallographically examining a worn rope wire crown. A white layer on the surface was noted and determined to be martensite. He told **Mr. C. G. Roebling**, who was then managing the John A. Roebling's Sons Company, of the examination. **Mr. Roebling** did not accept the explanation at that time but did later in the next year when there was a paper by **J. E. Stead**[1] on the same subject which told of martensite on worn-rope wire crowns. Although **Dr. Boynton** had not published anything on this subject it is believed that he was the first person in this country to note the presence of martensite on a rope wire crown.

* * *

IN the examination of this rope wire crown **Dr. Boynton** noted that martensite existed only where the surface had been abraded. It was concluded that the contact of this wire crown with some foreign matter such as rock or metal generated heat rapidly enough to raise the temperature of the abraded area above the critical temperature so that the surface layer was austenitized, and its cooling was so rapid that martensite was formed.

* * *

SINCE that time, martensite on worn rope wire crowns has been observed frequently and Figure 1 shows a typical layer of martensite on a rope wire crown with cracks in it. Various people have felt that the rope wire steels of varying carbon content differed in their susceptibility to the formation of martensite. Their thoughts also included the feeling that one .60% carbon heat of steel differed from another .60% carbon heat of steel in its susceptibility to the formation of martensite. Service experience seemed to indicate that rope wire having .60% carbon and higher was more susceptible to the formation of martensite than that with less than .60% carbon.

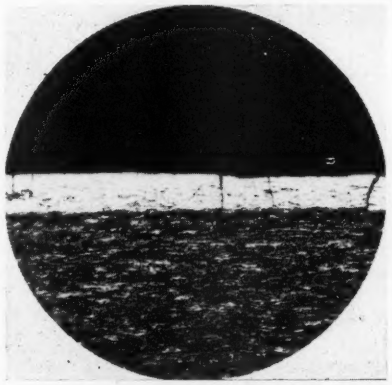


Fig. 1. — Typical Layer of Cracked Martensite on a Worn Plow Steel Rope Wire Crown. 100 Diameters. * * * * *

* * *

THE purpose of this paper is to discuss the reason for service life variations in wire ropes from the viewpoint of the possible presence of martensite. In many applications of wire rope abrasion is one of the factors involved, and the following are ones in which abrasion and martensite are closely associated. One is a drilling line which is slipped through the clamp with the clamp not always free from the rope. The rope slips at a great speed due to the weight of the rope and drilling tools. In slipping, the rope wire crowns bear against the clamp and martensite forms on the wire crowns. Another example is an incline rope. When the dump car at the top of the incline is released, it descends with great speed and the attached wire rope abrades against the metal cross ties At night sparks can be seen, a fact testifying to the high temperature caused by abrasion.

* * *

THE main consideration is the formation of martensite on wire ropes. In service, martensite only occurs in the wire crowns of a rope and is associated with abrasion in which frictional heat is generated. If the abrasion is insufficient to cause a rise in temperature above the lower critical, martensite cannot form. The first assumption is that sufficient heat is generated to raise the temperature of the wire crown up to the austenitizing temperature. A study of a portion of the iron-carbon equilibrium diagram in Figure 2 has a bearing on this question. If the temperature rises above the AC1 line austenite can occur in any steel. As the carbon content is lowered, the AC3 line or the upper critical shows that a higher temperature must be reached in order to austenitize completely a surface layer. The carbon range of rope wire steels ordinarily is .40% to .85% carbon and the difference in the upper critical temperature for the foregoing limits of analysis is approximately 90°F.

* * *

HOWEVER, heating rope wire crowns by friction up to the austenitizing temperature would be at such a rate that 90°F difference would probably be of little consequence. Such friction under service conditions is an unknown quantity and an uncontrolled one. The speed of heating by friction is such that equilibrium conditions at the maximum temperature attained are never realized.

* * *

IF it is assumed that service conditions are such that frictional heat is sufficient to raise surface layers to temperatures which form austenite, why do some rope wires (notably ones with higher carbon content) break due to martensite formation while others do not?

* * *

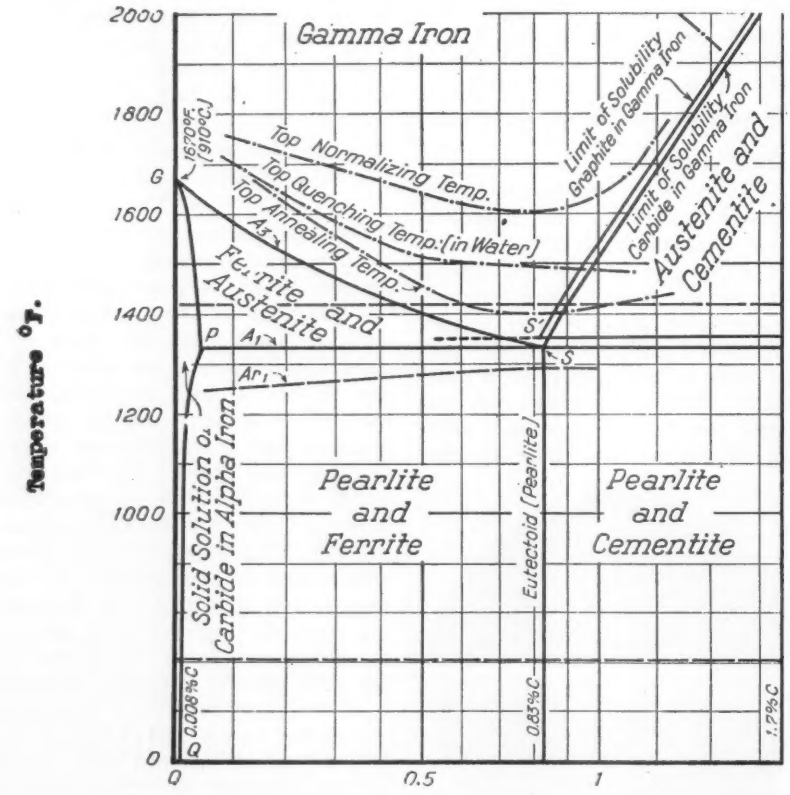


Fig. 2. — Portion of the Equilibrium Diagram for Steel. * * * * *

THERE are two possibilities. One is that the rate of cooling of the austenite is variable, sometimes forming martensite and sometimes pearlite. The other is that the ductility of the martensite varies and brittle martensite cracks causing broken wires whereas more ductile martensite does not crack

* * *

IN the following discussion, reasons are given for believing that service life variations are not due to the first of the above possibilities and are entirely due to the second. The experimental part of the paper deals with the second possibility and shows that the ductility of the martensite formed on rope wire varies primarily with the carbon content of the wire.

* * *

IN order to discuss the first of the above possibilities it is necessary to know whether the actual cooling rate of the austenite is near to the critical cooling rate.

* * *

THE rate of cooling of the surface layer of austenite is determined by conduction of heat to the cool interior of the wire rather than by surface radiation which is relatively much slower. The rate of cooling will therefore depend upon the temperature gradient between the surface layer and the interior of the wire which in turn will depend upon the rate of heating.

* * *

IF the cooling rate of the surface layer of austenite is insufficient for full hardness the microstructure should show pearlite or a mixture of martensite and pearlite. The laboratory has examined a great number of martensitic rope wire crowns and never has any such mixed or pearlite structures been observed.

* * *

ANOTHER piece of evidence that the rate of cooling of the austenite is always faster than the critical cooling rate comes from a study of resistance butt welding where there is a very steep temperature gradient. The section between the welding jaws is heated to the welding temperature while the material in the immediate contact of the jaws is cold. The great volume of heat generated is sub-

sequently dissipated mainly by conduction cooling. In a weld made in a piece of .132" diameter .45% carbon steel wire, the overall heat affected zone was approximately one inch long and the cooling time approximately seven seconds. The cooling time includes only that time in which the weld bead cooled from the welding temperature to the point where it lost its color In this particular instance the heat affected zone was approximately 75% martensite.

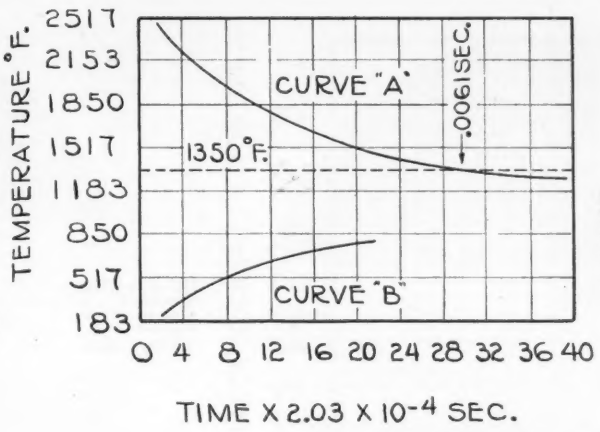


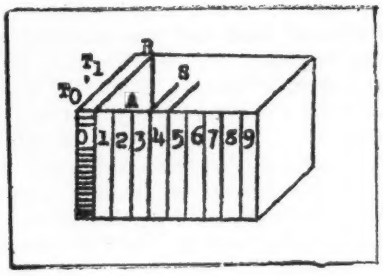
Fig. 3. — Curve "A" shows time necessary to cool a segment, .001" thick from 2600°F. Curve "B" shows temperature rise in the second thousandth of an inch.

* * *

IF 75% martensite occurs under the foregoing conditions of slow cooling, the possibility of forming 100% martensite on a rope wire crown is uncontestable where the heat affected area is generally .000-.003" thick and the adjacent volume of cold metal is proportionately very much greater.

* * *

A third evidence to satisfy the statement that the critical cooling rate is exceeded is along mathematical lines. It was assumed that a layer of surface metal .001" thick, 2" long, and .070" wide had been heated to 2600°F and subsequently cooled by conduction (i.e. dissipa-



E = Initial energy in the piece Q_0

A = Area heated. 2" x .070" = .14 sq.in.

R = Thickness assumed heat = .001"

C = Conductivity of metal = 25 B.t.u's/sq.ft./hr. °F/ft.

H = Specific Heat = .15

D = Density = .282 lbs./cu.in.

T_1 = Initial temperature (before blow)

$T_{0,1,2}$ = Temperature after blow.

$T_0 = T_1 \neq \frac{E}{ARHD}$, $T_{1,2} = T_1$

Q = Heat transmitted in a time interval t, (Q_{11} from 0 to 1 in time t_1)

t = Arbitrary time intervals chosen to allow transmission of some arbitrarily small quantity Q, from 0 to 1 in early intervals.

t_1, t_2, t_3, need not be uniform.

$Q_{11} = \frac{2CAt_1}{S} T_0$, where S = width of 1,2, etc.

then $Q_{01} = Q_0 = Q_{11}$, $T_{01} = T_1 \neq \frac{Q_{01}}{ARHD}$ since ARHD = constant, let it be computed and = K = .00000592 since T_1 is a constant (70°F approximately) let it be the reference temperature and omitted from calculations (A constant addition in any column of T).

TABLE 1. MATHEMATICAL METHOD FOR DETERMINATION OF COOLING RATE. * *

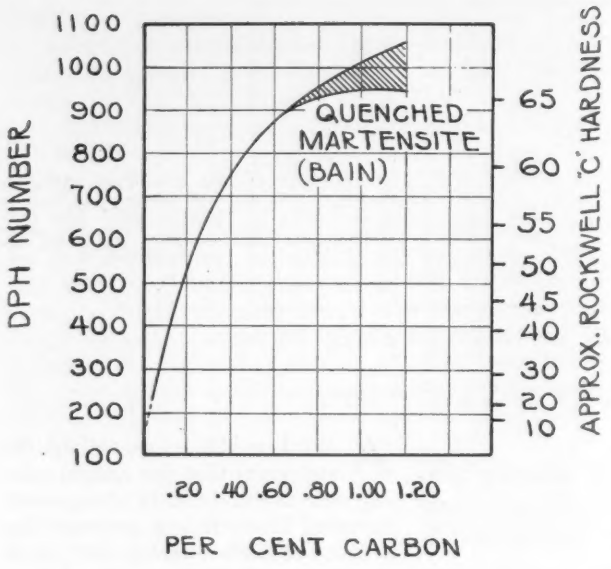


Fig. 4. — Hardness of Quenched Martensitic Carbon Steels as a function of carbon content. (Bain) * *

tion of heat within the wire itself). Heat losses due to radiation and absorbtion of heat by the tool are not reflected in the results. The calculations were based on the formula

$$T_0 = T_1 + \frac{E}{ARHD}$$

this is one of several applicable formulas from which a reasonable answer could be obtained. The explanation of the terms are shown in Table I. Curve A of Figure 3 shows the time necessary to cool a segment .001" thick from 2600°F to 1350°F. Curve B of Figure 3 shows the temperature rise in the second thousandth of an inch as the temperature in the first thousandth of an inch decreases. Curve A shows that the rate of cooling is by far rapid enough to cool past the "nose" of the S-curve. The assumptions are such that the actual speed of cooling is probably faster than that calculated. The actual speed of cooling in terms of seconds is at the rate of about 200,000°F/second in the range of 2500°F-1350°F. This speed is in comparison to known cooling rates of 320°F/second[2] and 663°F/second[2] determined at 1022°F for an 84% carbon and a .57% carbon plain carbon steels respectively to produce 100% martensite in very small sized samples. The rates of cooling were determined on material austenitized at 125°F-160°F above the A-3 line.

FROM these three lines of investigation it is concluded that if a thin layer of metal on a rope wire crown is heated above the upper critical temperature that full martensitic hardness will be attained upon cooling. The formation is solely dependent on the temperature to which the surface is raised by friction and not at all affected by the method of manufacture or the chemical analysis within the range of .40% to .85% carbon rope wire steels. Consequently any differences in the service life under conditions where martensite is present are solely dependent on the properties of the martensite.

* * *

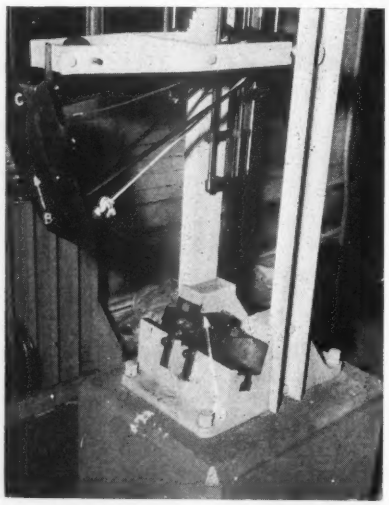


Fig. 5. — Converted Izod Impact Testing Machine. * * * * *

THE experimental work here described involves the determination of the properties of a layer of surface martensite on a rope wire crown. **Bain's** curve[3], Figure 4, for quenched martensite shows a tremendous difference in the hardness of various carbon martensites. As the carbon content of steel increases the hardness of the martensite increases and the ductility decreases. Therefore an investigation of the ductility of martensite layers on a .41%, .50%, .60% and .78% carbon rope wire ranging in diameter from .071" to .078" diameter was made.

* * *

AN Izod Impact testing machine[4] in which a piece of wire was struck a blow with an abrading tool was used in the experimental work and is shown in Figure 5. The wire was held in clamp (A) so that it had a slight radius. A hardened steel tool was fastened to the hammer (C) and the tool (B) struck the wire a glancing blow and the absorbed energy was measured in foot pounds. The striking tool contained a rounded piece of carboloy as the contacting point. Use of the carboloy eliminated nicking of the tool as well as pieces of the tool welding onto the wire and resulted in a uniformity of tests. The martensite produced was solely a part of the wire. The use of dissimilar metals decreased the amount of friction which decreased the heat generated and likewise the depth of the martensitic layer formed.

* * *

THE machine has a series of energy levels ranging from 9.6 ft. lbs. to 117.5 ft. lbs. As the samples were prepared at a constant tool interference of .020" (arbitrarily selected) the 33 ft. energy level was the lowest setting at which the hammer would complete its swing. The weight of the hammer system and tool was 47 lbs.

* * *

TWO series of samples were prepared. The first was made at 33 ft. lb. energy level with a tool interference of 0.20". The average thickness of the martensite increased from .00077" on the .41% carbon wire to .00119" on the .78% carbon

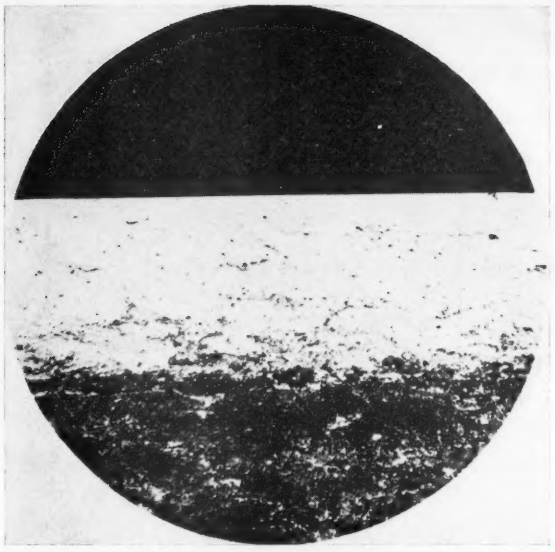


Fig. 6. — Photograph of a Martensite Layer on a .078″ Diameter, .78% Carbon, .55% Manganese Steel Wire under the following conditions: Energy Level 117.5 ft. lbs. (Izod Scale), Carboloy Striking Tool, .020″ Depth of Tool Interference. 1000 Diameters.

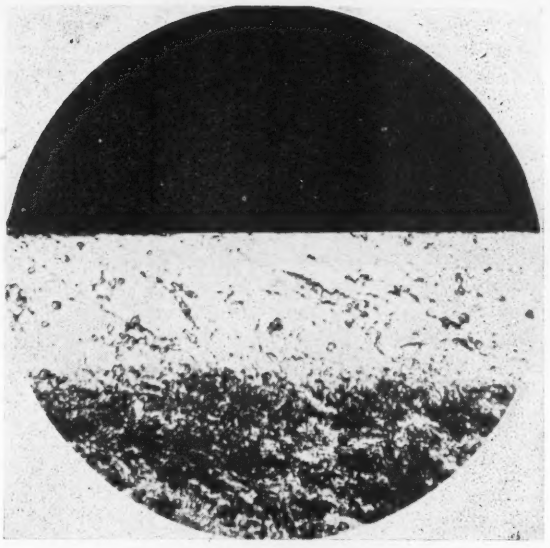


Fig. 7. — Photomicrograph of a Martensite Layer on a .50% Carbon, .49% Manganese Steel Wire Under the following conditions: Energy Level 117.5 ft. lbs. (Izod Scale), Carboloy Striking Tool, .020″ Depth of Tool Interference. 1000 Diameters. * *

wire. The second series was made at 117.5 ft. lbs. of initial energy and the thickness varied from .00098″ on the .41% carbon wire to .00126″ on the .78% carbon wire. This showed that as the carbon content increased the depth of martensite formed increased when equal abrading forces were employed. However, the high carbon wire was more resistant to impact due to its greater hardness. This greater resistance very likely resulted in a greater depth of heat penetration and a heavier layer of metal being austenitized.

* * *

TYPICAL layers of .78% carbon and .50% carbon martensite on rope wire are shown in Figures 6 and 7 respectively. In general both layers are similar in that they are a solid layer with a distinct demarkation between the martensite and the hard drawn structure underneath. The layer in Figure 7 contains a few grains of ferrite which apparently were not solutioned. The grains of ferrite mainly are present in the inner portion of the martensite layer which indicates a difference in solutioning across the thickness of the layer. The presence of the ferrite very likely has some effect on the ductility of the martensite layer.

* * *

Fig. 8. — View of Typical Cross Ruptures on an Abraded Surface in .60-.85% Carbon Martensite.

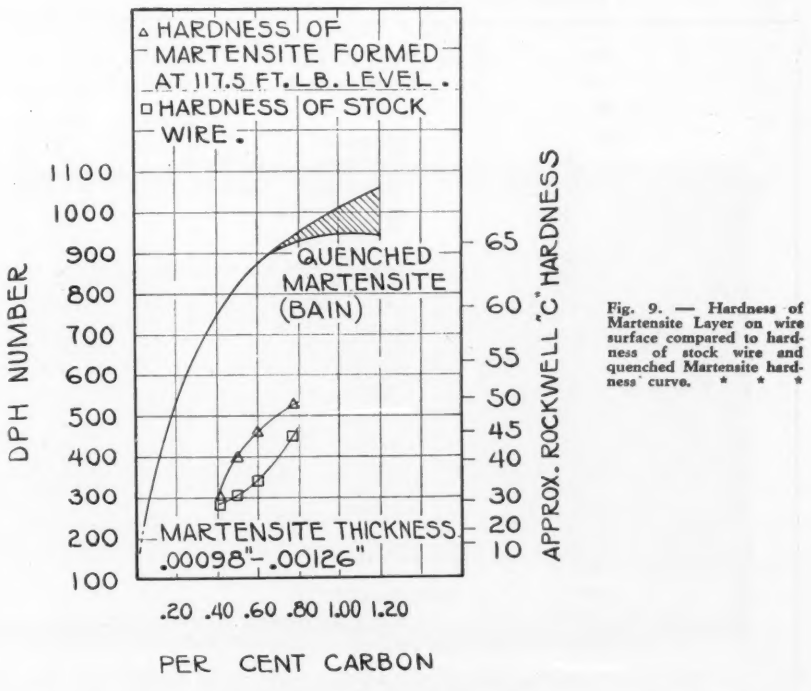


Fig. 9. — Hardness of Martensite Layer on wire surface compared to hardness of stock wire and quenched Martensite hardness curve. * * *

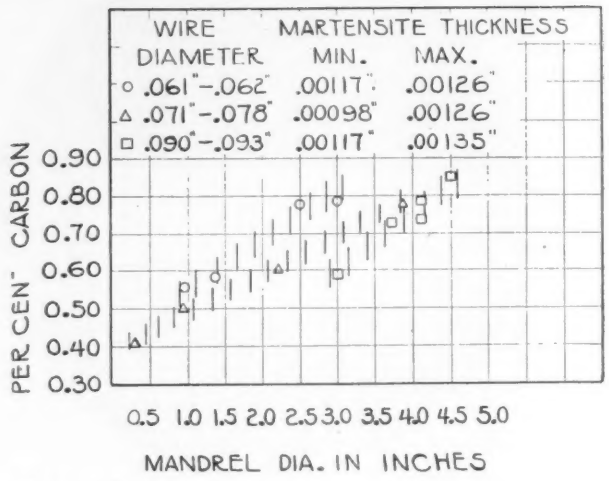


Fig. 10. — Relationship between carbon content and maximum amount of bending before failure of martensite layer. * * * *

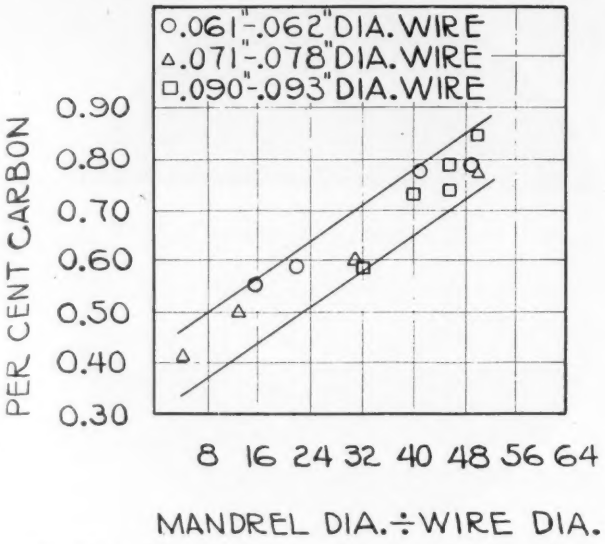


Fig. 11. — Relationship between carbon content and the maximum amount of bending before failure of the martensite layer. * *

THE bend test was used as the criteria of the ductility of the martensite. The wires were bent over a .740″ diameter mandrel which is roughly ten times the wire diameter. A protractor was positioned behind the mandrel so that the angle of bending could be accurately read. The wire was bent very slowly from the normal position until the martensite exhibited cracks which were determined by the use of the binocular. The wires were bent only one 90° bend or less. A view of such cracks is shown in Figure 8 and the results of the testing are shown on Table II. The .41% carbon and the .50% carbon did not show any cross ruptures after bending, but the .60% carbon and the .78% carbon wires did exhibit cross ruptures. The angle of bending before rupturing increased as the carbon content decreased.

* * *

HARDNESS readings were also made on the abraded surfaces and the results are shown on Figure 9 and Table II. **Bain's** curve as well as the hardness of the stock wire is also introduced for comparison purposes. The hardness of the martensitic layer due to its thinness reflects not only the hardness of the martensite but the hardness of the metal supporting the martensite. However, the martensite hardness increases as the carbon content increases.

* * *

THE bend test was not altogether satisfactory because the wires were so stiff that they did not conform to the curvature of the mandrel and therefore the radius of curvature was somewhat indefinite. Thus, it was decided to wrap the wire around a mandrel. The size of the mandrel would be varied and the smallest diameter over which the samples could be bent without the martensitic layer cracking would be noted.

* * *

TABLE II

PROPERTIES OF MARTENSITE PRODUCED ON ROPE WIRE UNDER THE FOLLOWING CONDITIONS:

Tool — Carboloy
Depth of Cut — .020″
Energy Level — 33 Ft. Lbs.

Sample	Wire Diameter	Martensite Thickness in Inches	Hardness C-Scale (c)	Bend in Degrees Over a .740″ Dia. Mandrel
.41C	.075	.00077 (b)		(a)
.41C	.075			(a)
.41C	.075		30	
.41C	.075	.00084 (b)	31	
.50C	.0745		38	
.50C	.0745	.00084		(a)
.50C	.0745	.00084	38	
.50C	.0745			(a)
.60C	.071	.00105		45°
.60C	.071	.00098	45	
.60C	.071		45	
.60C	.071			50°
.78C	.078			38°
.78C	.078		51	
.78C	.078	.00119		45°
.78C	.078	.00119	51	

* Angle at which continuous cross ruptures appeared.

(a) No continuous cross ruptures appeared.

(b) Thickness of total heat-effected area. The thin skin of continuous martensite was less than 25% of the heat-effected area.

(c) C-scale readings converted from 15N Scale, 15Kg. Load.

TABLE III

MATERIAL USED IN FORMING MARTENSITE

Diameter	% Carbon	% Manganese
.093″	.59	.57
.092″	.73	.56
.092″	.74	.55
.090″	.81	.60
.090″	.79	.52
.090″	.85	.58
.078″	.78	.55
.075″*	.41	.59
.0745″	.50	.49
.071″	.60	.66
.062″	.78	.55
.062″	.56	.56
.062″	.59	.45
.061″	.79	.64

* The .41% carbon wire was drawn six holes from .187″ diameter raw rod.

THE work was carried out on the set of wires already tested as well as on two other sets having diameter ranges of .061″-.062″ and .090″-.093″. Each of these sets had a range of carbon content and the description of the wires employed is shown on Table III.

* * *

THE results of this work were plotted against carbon content and are shown in Figure 10. In each wire size group there is a linear relationship. The slopes of the bands are not exactly the same but are very close. The variations in the layer thickness are shown on Figure 10 and are of such magnitude that the width of the bands is fairly constant. The thicknesses were controlled as closely as possible because values on either side of this range would either result in the martensite accepting a less severe bend when a heavier layer was present or a more severe bend when a thinner layer was present.

* * *

TO tie together the effect of difference in diameters the mandrel diameter was divided by the wire diameter and plotted against percentage carbon. The resulting curve is shown in Figure 11. This manner of plotting eliminates the effect of wire diameter and results in a curve with a rather wide band. For any one carbon content the range of values of mandrel diameter to wire diameter is quite broad. However, the band indicates that irrespective of wire size there is a definite relationship of the amount of bending which various carbon content martensite will withstand.

* * *

A few remarks are necessary about the characteristics of the cross ruptures in the bent wires. Figure 12 shows two samples which had been bent until cracks appeared and then re-straightened. Sample A shows the typical distinct cross rupture in a .60% and higher carbon martensite. Sample B shows a representative sample for a .40%-.55% carbon martensite. In Sample B the cracking can be considered more of a tearing action. The tearing action started from the edges of the abraded surface with increased bending. A sample was considered to have failed before the tear had proceeded across the surface as one continuous crack. The range of .55%-.60% carbon appears to be the transition range in the two types of rupturing.

* * *

THE conditions presented are only one of many possible variations. With different conditions of forming martensite, the results may be slightly different. However, it is felt that the data presented adequately describe the fundamental relationships which exist.

* * *

IN summarizing we conclude that if rope wire crowns are heated by friction in service above the critical temperature, martensite will form on cooling. Once the martensite is formed, its ability to withstand cracking depends on the carbon content. It has been shown that

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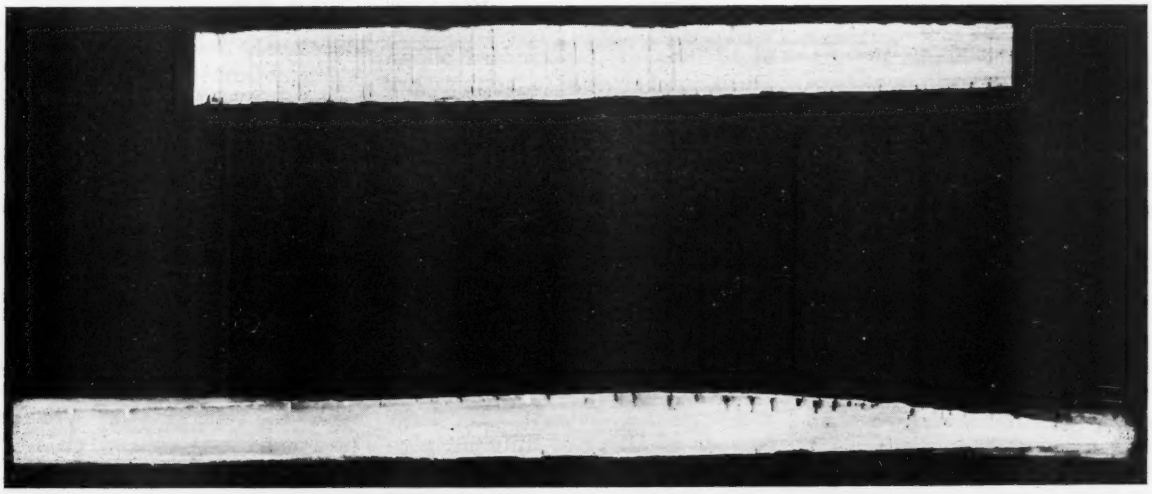

Fig. 12. — Sample A — Typical Crack of a .60-.80% Carbon Martensite on an Abraded Wire.
Sample B — Typical Crack of a .40-.55% Carbon Martensite on an Abraded Wire. * * * * * *

BRASS WIRE PROCESSING

By Christian Witteveld
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Bridgeport Brass Company
Bridgeport, Conn.

An analysis of the extruding and drawing involved in the production of Brass Wire. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

IN the many articles pertaining to the art of wire production, the greatest emphasis has been placed on the processing of steel and copper wire. This is understandable in the light of the volume of business produced annually in the respective fields of steel, copper and brass wire. The volume of brass wire mill products is in the neighborhood of 50,000 tons annually which is only approximately .02% of the steel wire production and 10% of the copper wire production. However, the importance of brass wire in the industrial field should not be minimized as the products made from this wire are used for a large variety of essential items, particularly in the electrical field and where non-corrosive materials are required.

* * *

IT is hoped that the following general outline on the processing of brass wire will present a picture of the problems facing the brass wire producers. The following applications and statements apply exclusively to the procedures used by one company and do not necessarily reflect the operations used by other producers.

* * *

THE term "brass wire" as used here includes not only the primary alloys of copper and zinc but the large field of alloys that contain, along with the primary metals, additional elements such as lead, tin, silicon, iron, cadmium, aluminum, manganese and others in varying proportions and combinations. This wire field also includes a number of the copper base alloys which contain no zinc. These alloys are usually called bronzes, the specific prefix depending upon the foreign element of greatest proportion, e.g., in aluminum bronze the major alloying element is aluminum to copper.

* * *

PROPERTIES such as ductility, springiness, toughness, strength, and stiffness are controlled either by annealing or by the amount of reduction by drawing following the last anneal. Machinability, corrosion resistance, hot and cold workability, etc., are controlled largely by modifying the proportions of copper and zinc, and by the addition of small quantities of the elements as mentioned above.

* * *

THE number of brass wire alloys is extremely large but much has been done toward standardization. In addition to the standard alloys, which number close to 30, there are also many proprietary alloys or specialties made only by individual companies.

* * *

BRASS wire produced at the **Bridgeport Brass Company** includes approximately 20 standard alloys as well as the many additional experimental alloys continually being developed to meet specific customers' requirements. The large number of alloys of different physical characteristics and the great number of physical specifications to be met in these alloys lead to many variations in processing from the raw stock to the finish sizes.

Raw Stock

TODAY, brass wire mills depend largely upon the extrusion method for obtaining the raw coil stock for subsequent redrawing to the finish sizes. Before the advent of extrusion, all raw stock was obtained by hot or cold rolling a cast billet or bar. Some hot and cold rolling is still in practice but the number of alloys produced by these methods is gradually being reduced as extrusion technique develops.

Extrusion

EXTRUSION is the method of forcing a cast billet under high pressure and at an elevated temperature through a die orifice of predetermined size. Extrusion was introduced in this country in the early twentieth century. When this method was initially adopted, the only alloys extruded were those with a copper content of from 55 to 61 per cent, but as extrusion developed, it was found that other elements could be added without seriously impairing the ability to extrude. The limitation in the mixtures that could be extruded were due to the low pressure capacity of the presses and the inability of extrusion tools, at that time, to withstand the pressures and temperatures. Gradually, with the advent of the high pressure extrusion presses and improvement in tool steels, it became possible to extrude a greater variety of brass alloys with the elements as previously mentioned and opened up a field for the production of high copper base alloys formerly considered impossible. Today it is generally con-

ceded that all copper base alloys can be extruded with presses of sufficient pressure if tool steels can be introduced to withstand the high temperatures and pressures involved.

* * *

INDUSTRY was quick to note the advantages to be gained by extrusion. Extrusion has largely replaced hot and cold rolling as the source of raw material for the following reasons:

1. **By extrusion it is possible to process alloys that cannot be hot rolled, such as the leaded mixtures or alloys which formerly were processed by cold rolling using numerous roll passes with intermediate anneals.**
2. **Mixture cost can be reduced for the extrusion of some alloys, as it is not essential that the content of the mixture for the extruded billet contain elements of high purity. For hot rolling, mixtures of high purity must be used so as not to introduce foreign elements that will affect the hot rolling operation and the quality of the stock obtained.**
3. **The quality of the finish wire obtained from extrusion is superior to that obtained from either hot or cold rolling. The as-extruded metal is free from the surface defects usually found on stock from hot or cold rolling.**
   Usually rolled stock must be draw scalped to remove the surface defects but this operation does not always assure full removal of this condition. Intensive tests are usually given material produced from rolled stock before it is shipped. Today, the high quality product obtained from extrusion is essential for manufacturing processes that subject the metal to severe forming operations.

* * *

THE prime factors limiting the extrusion are the press capacity (available pressure) and the extrusion tool life. The extrusion pressure required depends upon the alloy, the temperature of the billet, the speed of extrusion, and the ratio of billet area to the area of the die orifice. As the ratio of billet area to die area increases, the pressure required to extrude increases and necessitates a reduction in diameter or length of billet that can be used.

* * *

THE extrusion potentialities of any alloy are usually predetermined before extrusion is attempted by results obtained from "drop hammer tests." The drop hammer test is a measurement of deformation on a heated slug, at a known temperature, by a predetermined hammer blow. From a comparison of the results obtained for the alloy being considered, with the results of drop hammer tests obtained on alloys for which extrusion has already been established, a fairly accurate determination of the extrusion temperature, extrusion pressure, billet size, and minimum extrusion size for the new alloy can be estimated.

* * *

EXTRUSION of the billet must take place in the temperature range in which the particular alloy can be hot worked, consistent with extrusion press limitations. The temperature range includes the difference between the minimum temperature where excessive pressure is required to extrude and the maximum temperature at which incipient melting of elements within the alloy may occur. It is therefore essential that the temperature of the billet during extrusion be controlled so that the temperature will not drop to the point where the extrusion pressure will not be sufficient to complete the extrusion, and, on the other hand, so that the billet temperature will not be so high that incipient melting will occur and cause cracks in the extruded metal.

* * *

SPEED of extrusion is also a determining factor in limiting the extrusion billet and extruded size. The speed of extrusion must be controlled so that the frictional heat of deformation within the billet as it is being extruded and the heat due to frictional heat when the metal is passing through the die will not raise the metal temperature to the point where incipient melting will occur and surface cracking result. Extrusion speeds vary with the copper content of brasses and will range between 100 feet per minute to 600 feet per minute.

* * *

TWO presses, one of a 2750 ton capacity and the other of 1600 ton capacity, are used at Bridgeport. Extrusion is gradually absorbing the alloys previously hot rolled and to date only few of the bronzes are now hot rolled. Work is distributed so that the lighter press is confined solely to mixtures readily extrudable or up to 65 per cent copper, and the heavier press to the more difficult extrudable alloys of higher copper content.

* * *

THE raw coil stock is extruded from billets ranging from 6″ to 10″ in diameter and 11″ to 30″ in length to sizes of from ¼″ minimum to 1″ maximum. Most generally, the alloys containing a copper content of up to 65 percent can be extruded readily and therefore with the larger diameter and length billets and to the lower range of sizes. As the copper content increases up to 85 percent, there is a tendency for the pressure and temperatures required for extrusion to increase and therefore the billet diameter and length must be correspondingly reduced and the die orifice increased. Alloying elements also generally affect extrudability so that the size of the billet must be reduced.

* * *

FOR coil stock, generally the maximum size that can adequately be handled by wire block processing equipment is 1″ diameter and billet temperature and size are usually determined to obtain sizes 1″ or below from either single or multiple hole extrusion. The coil weight obtained from the extrusion is also a determining factor and coil weights of 200 pounds have generally been established as a desirable minimum in order to keep processing costs in line.

* * *

NOT all of the metal extruded is usable. From 15 to 25 percent of the original billet weight is discarded before the material is processed. The defective material is caused by the oxidation of the billet surface. This oxidized surface is drawn into the extrusion stream toward the end of the extrusion stroke and does not form a bond with the clean material. The last section of the extruded stock containing this oxidized metal must be cut off. This defect or "piping" is removed from the coils by specially designed equipment which automatically breaks the stock so a fracture is obtained which exposes the inner structure. Examination of the metal interior is continued until

all the defect is removed. In brasses of low copper content, this extrusion defect is normally in the center of the stock but for the high copper brasses and bronzes the defect appears also on the surface. To reduce the amount of defect, it is desirable to extrude the billet within the shortest period of time and at the lowest billet temperature and to keep the extrusion tools heated to a suitable temperature so that the chilling of the billet will be minimized. Present practice is to extrude so that a shell is left within the container, thus preventing the oxidized surface from entering the stream during the earlier stages of extrusion.

* * *

A close check, however, must be maintained on the economics of extrusion. As billet sizes must be reduced for the more difficult extrudable alloys, a point is reached where the cost of extrusion and subsequent processing may exceed the cost of hot rolling and processing.

Drawing

PROCESSING equipment must be flexible in order to make use of the full drawing potentialities of all the alloys made. The ability of a metal to be cold worked depends upon its physical characteristics, primarily on its initial hardness, work hardening capacity, and ductility. Mechanical factors such as tool life, die shapes, equipment capacities and lubrication will also influence the amount of cold reduction that can be given but these factors are subject to a large extent to mill control.

* * *

THE number of alloys produced with their varying physical characteristics tend to complicate processing procedures. The amount of cold working that can be done without annealing varies from 20 per cent for some bronzes up to 90 per cent for the high copper content brasses and bronzes. Because of the radical differences in the alloys produced and the varying reductions that can be given, drawing equipment consists of both single and multiple die draw blocks. Drawing equipment is usually operated by d.c. motor with controls for gradual acceleration to prevent breakage at the start of the draw and for intermittent operation and to provide a range of drawing speeds that can be adjusted for the alloy being drawn.

* * *

THE single block drawing equipment at Bridgeport consists of blocks of 20,000, 10,000 and 5,000 pound draw pull capacity with draw speeds ranging from 115 to 400 feet for the heavy duty blocks, 200 to 800 for the intermediate blocks, and 200 to 1,000 for the light blocks. These single draw machines are equipped with draw blocks ranging from 8″ to 30″ in order to supply the various coil diameters requested. Generally, the heavy duty wire blocks will be used for drawing to sizes ½″ and up, the intermediate blocks for sizes ½″ to ¼″, and the light blocks for sizes under ¼″.

* * *

THE continuous draw wire machines consist of one 9 die heavy duty machine with a maximum entering size of ½″ and two smaller 7 and 8 die machines with a maximum entering size of .128″. The heavy-duty continuous machine contains 9 dies in series with seven draw capstans between the entering die and finish die. The reduction between dies is one Brown and Sharpe number with a two number reduction generally obtained between the entering size and the first die. Not all capstans need be used so that reductions of from 6 to 10 Brown and Sharpe numbers can be given the wire drawn on this machine. Wire can be taken off at sizes anywhere between .204 and .064 at draw speeds of between 1000 and 2000 feet per minute. This machine is used primarily for furnishing wire for stock from which material for small diameter wire orders are drawn and for stock for the smaller pin wire machines.

* * *

THE two smaller continuous wire machines are of the cone type and are used for furnishing sizes down to .028 at draw speeds of between 600 to 2000 feet per minute. For continuous wire drawing, the coils are butt welded, the weld becoming an integral part of the metal. Specific coil weights from the continuous machines are controlled by the use of counters on the blocks.

* * *

THE draw speeds at which wire can be drawn are dependent upon the following factors: machine capacities and speeds, the alloys being processed, lubrication, finish surface requirements, the finish size, and the final area reduction.

* * *

MACHINE capacity and speeds are mentioned as influencing the drawing speeds since wire equipment has definite stated draw pull capacities and range of drawing speeds and are equipped with d.c. adjustable speed motors where the speed can be varied with the change in the load. The reductions given wire and the draw pull required for these reductions will determine the drawing speed available. This is generally the case for the process breakdown draws on the heavy duty blocks where area reductions of up to 60 percent can be obtained, depending upon the alloy. This affect is particularly noticeable in the drawing of the bronzes where the hardness and stiffness of the metal is appreciably increased by drawing.

* * *

TOTAL area reductions ranging from 5 per cent to 90 per cent are given wire in order to obtain the final specifications desired. High copper brasses and the bronzes are generally requested with high tensile specification, requiring heavy reductions, and the low copper alloys are generally furnished with final reductions ranging from 5 to 25 per cent. It is in this last category that control in drawing speeds must be exercised so that the finish surface meets the quality desired and the gauge does not vary throughout the coil length.

* * *

GENERALLY, sizes to finish ¼″ and above are completely processed by single block drawing operations. For sizes below ¼″, the stock from the initial block breakdown is passed through the heavy duty continuous wire machine and then redrawn to finish on either the single blocks or the smaller continuous wire machines.

THE average number of drawing operations from the extruded size to the finish size will vary considerably for the various mixtures, but generally the finish size can be obtained in from 2 to 6 drawing operations, depending upon the finish size. The main influencing alloying elements that contribute toward the need for more than average drawing operations are aluminum, manganese, iron, silicon, and phosphorus which cause the alloy to increase appreciably in hardness and stiffness when drawn.

Dies

AS frequently mentioned in many of the articles written on wire drawing, the tungsten carbide die has been the greatest advancement in wire drawing for many years. It has contributed to the high drawing speeds now used, in maintaining uniformity of gauge and in reducing tool costs, production delays and mill scrap.

* * *

DIE life primarily depends upon the alloy drawn and the lubricant used. Die shape is a contributing factor in that much can be done toward reducing the heat during draw, increasing the area reduction that can be given in one operation and reducing the draw pull required. Control of the die contour for the final draw is of great importance in obtaining close control of size variations, and toward obtaining final quality of material.

Lubricants

SOAP base and dry soap lubricants are used almost exclusively, both on the single and multiple die wire machines. Soap solutions are used on the continuous wire machines and contain from 1 to 3 per cent fatty acid, the solution for the smaller machines having the least fatty acid content. The solutions are pumped from reserve tanks and sprayed onto the wire and drawing dies and returned to the reserve tanks. The reserve tanks contain cooling coils to reduce the lubricant temperature for more effective lubrication as well as to prevent the rapid evaporation of the more volatile elements in the solution. The lubricant for the single block draws is coated on the metal by dipping the coils into a soap solution and permitting the solution to dry on the wire. No additional lubricant is added at the blocks, the soap coating being sufficient for practically all drawing operations.

* * *

LUBRICANTS must be made up of elements that will not discolor (red stain) the wire when carried over on the metal through the anneal and pickle.

Annealing

GRAIN size has generally become the adopted method for specifying soft temper finish wire. In order to obtain the final grain size requirements, the drawing and annealing during processing must be closely coordinated.

* * *

THE raw stock, due to the high temperatures of extrusion, has an enlarged grain structure which will vary throughout the length of the extruded coil. Common brass mixtures as extruded will have a grain size dependent upon the mixture, extrusion temperature, the extrusion pressure required and the speed of extrusion. This raw stock is generally cold worked to its limit before annealing. This initial cold working is essential in order to obtain a more uniform recrystallization in the subsequent annealing after draw.

* * *

THE conditions influencing the time and temperature for anneals are: the composition of the alloy, the amount of previous cold working, the amount of cold working still to be done, and the diameter of the wire. The physical furnace specifications such as furnace capacity, method of loading, and source and application of heat are also determining factors.

* * *

PROCESS anneals or anneals between block draws where the wire is being reduced as a means of getting down from the extruded size to the ready-to-finish state are at higher temperatures so as to obtain the maximum ductility. At Bridgeport, the process anneals are done in roller hearth, direct fire continuous feed type furnaces with a cycle of 1½ to 2 hours with metal temperatures ranging from 920°F to 1250°F and a capacity of from 6000 to 7000 pounds per hour. The final anneal, where close control is essential to obtain the final grain size specification is done in the batch type convection furnace. This type furnace provides the most uniform distribution of heat and for temperatures 1250°F and below is the best adaptable for obtaining uniform grain size requirements. The cycle is again from 1½ to 2 hours with metal temperatures of from 800°F to 1200°F at a capacity of 2000 to 4000 pounds per hour.

* * *

MOST alloys can be quenched directly after extrusion without affecting the grain structure but generally alloys below 65 per cent copper are air cooled to a temperature of 900°F or lower so as to reduce the possibility of trapping secondary beta grain constituent which will increase the metal hardness and reduce its cold working properties.

Cleaning

DURING the annealing process an oxide coating is acquired which must be removed before further redrawing can be done. The agents used to remove this oxide or scale may be either a dilute solution of sulphuric acid or a solution of sodium bichromate and sulphuric acid. Generally if the wire is to be drawn and process annealed, a sulphuric acid dip is sufficient, but if the metal is at the ready-to-finish stage, it is given both a sulphuric and sodium bichromate cleaning to insure full removal of all oxides and to bring out the true color of the metal and thereby improve its appearance.

* * *

THE sulphuric acid content for the straight sulphuric acid solution ranges from 5 to 8 percent of acid by weight and for the bichromate solution a content of 5 to 8 percent of both sulphuric acid and bichromate by weight. Practice varies throughout the industry in this respect, depending upon the type

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alloy in which the volume production lies. The metal will be etched or pitted if it is immersed too long in the pickling solution. Proper conditions for operation can quickly be found by trial.

* * *

SEPARATE acid tubs for the cleaning of the high copper alloys and the alloys of common brasses are maintained. The cleaning action on the copper alloys is accelerated by heating the solution to about 120°F. The high brass mixtures are not cleaned in the copper cleaning tubs for fear of etching the metal by the accelerated action of the hot acid or discoloring the metal by coatings of copper scale.

* * *

ALL metal must be thoroughly rinsed after cleaning to remove all traces of the acid solution. Stains will appear on the metal if not thoroughly rinsed and at least two separate washings in water should be used before drying. Material finished soft is sent to a dry-out furnace after cleaning to remove, as soon as possible, all moisture clinging to the wire. This will prevent the wire from water staining so that surface appearance will be uniform for all coils.

* * *

BY far the most common defect encountered in pickling is the presence of red stain on the metal. Whether the red stain is copper or cuprous oxide, it may be removed in a bichromate pickle. Red stain on brass is usually caused by lubricating materials being left on the surface of the brass before annealing. Some lubricants have a greater tendency to cause this than others. Less frequently, the presence of metallic iron in contact with the brass during pickling is a cause of red staining, but here the staining only takes place close to the point of contact and is not widespread. In this case it is caused by the copper plating out on the parts because iron is anodic to copper. Great care must be taken to prevent any stray pieces of iron, such as nails or tools, from entering the pickling solution.

* * *

IN order to bring out the true color of high copper brasses and bronzes,

(*Please turn to page* 992)

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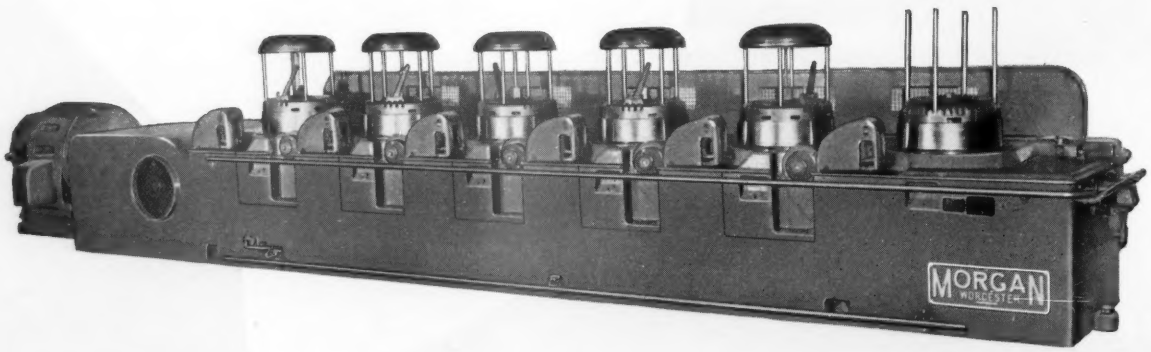

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The Control and Production of High Carbon Wire

By Jerry G. Weiss, Supt.,

Patent and High Carbon Wire Dept.
Keystone Steel & Wire Company
Peoria, Illinois

A description of control methods involved in the different processes connected with the production of high carbon wire. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

THE production of high carbon steel wire presents many varied and complex problems. It is not my intention to attempt here to deal with any specific problem, but rather to give a general resumé of the different processes and precautions necessary in the wire mill to produce the finished product.

* * *

SELECTION of the proper grade of steel must be made to meet the requirements or specifications of the customer. The size of rod to be used will, of course, depend upon the ultimate physical properties desired. A number of different grades of steel and sizes of rods are necessary to satisfy all demands in the most economical manner. At Keystone we regularly carry seven different grades of steel for the production of rope and strand wire, four for the various types of spring wire, and three for special purpose wire for such applications as lock washers, screwdriver blades, fishhooks, etc. These steels may be rolled into eight different sizes of rods.

* * *

IN order for the mill set-up or scheduling man to process the correct stock to meet the final specifications, he must make a few preliminary calculations. Each mill will have its own formulae and charts to facilitate these observations. Example charts currently used in our mill are shown in Charts A and B.

* * *

WHEN the correct steel grade is determined, the rods are trimmed and tested. In this operation, both ends of each coil of rods are trimmed to remove fins, laps, or overfills. A four inch length of rod is then given one complete twist and untwisted. The sample thus twisted is etched in acid to expose any seams, laps, or other surface imperfections. After the surface inspection the sample of each end of each coil is nicked and broken and the fractures thus obtained are inspected for pipe and segregation. All rods showing any of these defects are rejected.

* * *

AFTER quality is thus insured, the rods are then patented. This operation is well known to all wire men as a conditioning heat treatment in which the rod or wire is heated well above the upper critical point for a few seconds, and then cooled rapidly in air, or quenched in a bath of molten metal or other suitable material. Due to the non-uniform rate of cooling throughout a coil of hot-rolled rods, the structure is quite variable. Figure 1 shows the variation in structure to be found in green rods. In our plant, all high carbon rods are patented before any drawing operations are performed. It has been our experience that the drawing of green or unpatented rods often causes trouble in subsequent pro-

CHART "A"

BASIC STRENGTH FACTORS FOR PATENTED STOCK

The sum total of the following factors equals the tensile strength of Patented rods:
Carbon x 950
Iron constant of 40,000 P. S. I.
Manganese hardenability factor.

MANGANESE HARDENABILITY VALUES

FOR STEELS UNDER .60% CARBON		FOR STEELS OVER .60% CARBON	
% MANGANESE	FACTOR	% MANGANESE	FACTOR
.49 — .54	30,000	.49 — .54	30,000
.55 — .59	32,000	.55 — .59	33,000
.60 — .64	34,000	.60 — .64	36,000
.65 — .69	36,000	.65 — .69	39,000
.70 — .74	38,000	.70 — .74	42,000
.75 — .79	40,000	.75 — .79	45,000
.80 — .84	42,000	.80 — .84	48,000
.85 — .89	44,000	.85 — .89	51,000
.90 — .94	46,000	.90 — .94	54,000

Example: Carbon .77% — Manganese .57%
77 x 950 = 73,150 P.S.I.
Iron constant = 40,000 P.S.I.
Manganese factor = 33,000 P.S.I.
Total or Patented tensile = 146,150 P.S.I.

cessing, due to frequent rupture of either the surface or internal structures. We say, then, that patenting makes the structure uniform, ductile, and highly plastic, one which lends itself well to cold work or drawing operations. Figure 2 shows the same sections of Figure 1 after patenting.

* * *

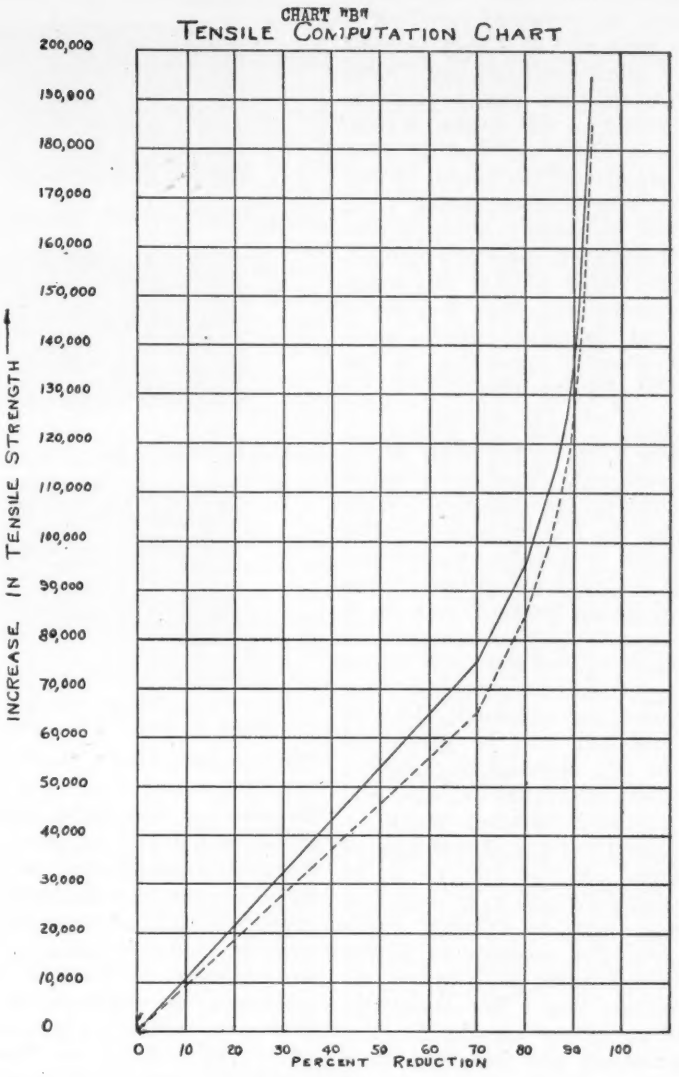
RODS and wire larger than 9 gauge are air patented in furnaces with hearths 6′ wide and 60′ long, heated to approximately 1850° F. Wire in the size range from 9 to 16 gauge is also air patented in the same size furnace, but at a temperature of 1800°F.

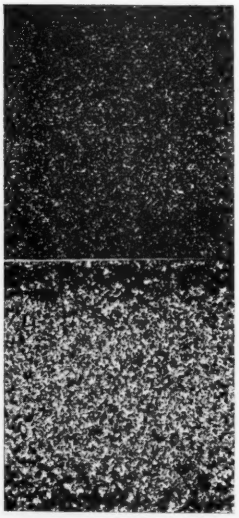
* * *

WIRE smaller than 16 gauge is run through smaller furnaces with hearths 3′ by 35′, at a temperature of 1550°F. These sizes are always quenched in lead at 900° to 1100°F. The quenching temperature may be varied to produce the desired tensile strength.

* * *

ALL of these patenting furnaces are heated with natural gas or fuel oil. Natural gas is the preferred fuel since it produces a more uniform temperature throughout the furnace. It is cleaner, operates with much less maintenance, and is much more economical. Fuel is supplied through three manifolds on each furnace, and the temperature in each zone is automatically controlled to a maximum variation of 10°F. A highly oxidizing at-



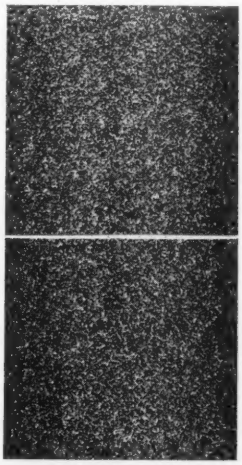


GREEN ROD

Section #1 from an outside strand that cooled rapidly.

Section #2 from an inside strand that cooled rapidly.

Fig. 1.—X4 Samples from same coil at .450" rod. .81% Carbon, .62% Manganese. * * * * *



PATENTED ROD

Section #1

Section #2

Fig. 2—X4 Same sections shown in Figure 1 after patenting. * * * * *

mosphere is maintained in the larger furnaces to purposely produce a heavy scale which is then cracked off by mechanical bending. After the rod or wire passes over the scale breakers, the surface is comparatively clean and free of scale. The normal steel loss caused by this heavy scaling is approximately 1.5%. This loss, however, is offset by lower cleaning costs since this material can be cleaned quickly and much more economically than if it had a thin and adherent surface scale which is quite impervious to the action of cleaning acids.

* * *

ONE of the more recently developed methods of patenting is the electrical resistance patenting machine. In this method, the wire is quickly heated by an electrical charge and quenched in lead, at any desired temperature. This type of patenting produces a very ductile and highly refined structure; it produces practically no scale, but a surface that is easily cleaned. The wire thus patented may be galvanized without any intermittent cleaning other than the usual muriatic acid bath used in galvanizing operations. Some disadvantages of this type of equipment are the higher cost of operation (this will vary according to power costs in different localities), and the necessity of having to run only wires of the same size at any one time. This latter disadvantage causes considerable loss of production and increases scrap when changing from one size of wire to another.

* * *

IN general, patenting is a simple form of heat treating high carbon rods and wire. There are, however, a few precautions necessary to prevent poor drawing qualities or possible complaint from the customer. Since good heat treatment is the result of proper time at the correct temperature, it is apparent that the speed of the rod or wire and the furnace temperature must be coordinated to produce the desired structure. As indicated above, the type of scale produced has an effect on the cleaning. If the scale is thin, unbroken and adherent, it is necessary to take every precaution to avoid overpickling or "burning", which generally causes excessive die wear, scratched wire, and affected physical properties.

* * *

ALLOWING rods to be stopped in the furnace for more than a few seconds is the most serious error possible to commit in the patenting process. If the rod is stopped, the section affected will be that short length just at the exit end of the furnace which has cooled too slowly. Cooling is retarded by the heat supplied from the adjacent section which is up to temperature in the furnace. Figure 3 shows the variations at this point when rods were stopped for different time intervals.

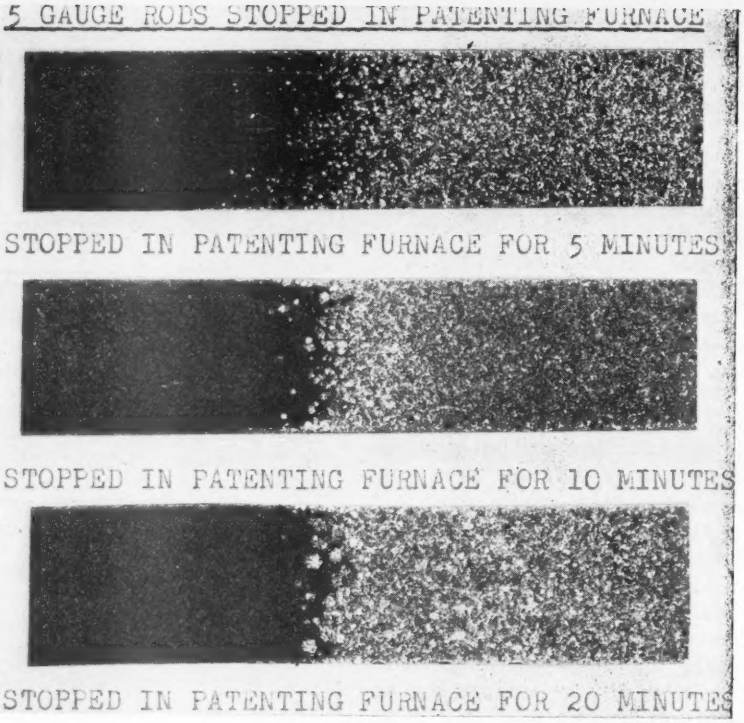

5 GAUGE RODS STOPPED IN PATENTING FURNACE
STOPPED IN PATENTING FURNACE FOR 5 MINUTES
STOPPED IN PATENTING FURNACE FOR 10 MINUTES
STOPPED IN PATENTING FURNACE FOR 20 MINUTES

Figure 3. X4 78% Carbon 58% Manganese * * * * *

* * *

FIGURE 4 is a composite macrograph showing a wire which broke in this affected area when the .343″ rod was drawn to .292″ wire (27.5% reduction in area).

* * *

IN the Cleaning House, the patented material is loaded on a hairpin yoke and immersed in a tank of about 6% sulfuric acid maintained at a temperature of 140°F, or lower. A commercial inhibitor is added to

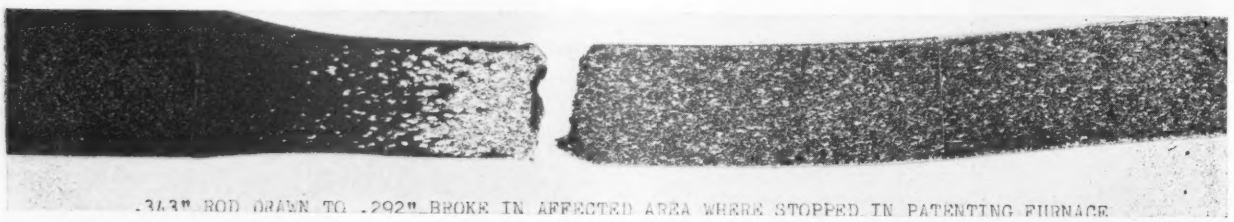


Fig. 4. X4 .94% Carbon .60% Manganese * * * * * *

prevent burning of the steel and to control the fumes from the bath. With the aid of mechanical agitators, the cleaning operation is usually completed in 20 to 30 minutes, after which the material is rinsed by dipping in a tank of running water. If a sull coating is desired, it is applied by allowing the yoke to hang in a very fine spray or fog. The water used here may be hot or cold, as desired. This is followed by application of a commercial phosphate or lime substitute coating, or, if preferred, the regular lime coating is put on, and the stock is then placed in the baker to dry.

* * *

FROM the bakers the stock is delivered to the drawing machine, where it is drawn through tungsten carbide dies to the specified sizes. The procedure usually followed to produce finished wire or wire for reprocessing is given in Table I.

* * *

ALL drawing machines are equipped with water cooled dies and blocks to dissipate the heat generated during the drawing operation. This cooling is absolutely essential if highest quality wire is to be finished at the indicated speeds. This will prove especially true where uniformity and close tolerances are required. In drawing rope wire, for instance, insufficient or improper cooling is reflected in a higher tensile strength with low and erratic torsional values. The torsion test is used also as a criterion of ductility, flexibility, and forming qualities for other grades of high carbon wire.

* * *

IT has been found that when drawing wire .120 and larger on large single blocks, even though they are water cooled, there is a progressive buildup of heat within the coil that seriously affects physical properties. The ends of the coil, or the outside strands, will show a normal tensile strength and high torsions while those strands inside the coil, subject to the higher temperatures, will have a tensile strength 10,000 to 20,000 p.s.i. higher, and possess low torsional values. These inside strands show a lumpy and seamed condition under the torsion test. This non-uniform condition within the coil has been overcome by blowing a blast of air on the wire during the drawing operation, or by actually passing the wire through cold running water immediately after it emerges from the die. The latter process is the most effective for rapid dispersion of the heat.

* * *

THE wire drawing lubricant to be used is selected to give good die life and preserve the wire surface. A brief history of the evolution of wire drawing lubricants might be interesting:

* * *

THERE was a time when the wiredrawer mixed his own lubricants according to his own empirical formula which he guarded very carefully and kept secret from everyone. His mixture might contain anything he could find that had a slick, smooth or soft feel when rubbed between the fingers. It was common practice for the wiredrawer to take his lubricant out of the die boxes at the end of his shift and either hide it or take it home as he did his rod-axe, pliers, and other working tools. This was especially true if the concoction produced good wire. Many times, however, it was found that what made good wire for one man could not be used by another. I never found the real solution to this mystery.

* * *

THE next phase found the individual plant supervisors designing and mixing large batches of lubricants for the different kinds of wire drawn in their mills. Each mixture was designated by a code number or letter, and the correct lubricant was specified on each order. In this manner, wire finishes became more uniform and the customer could expect the same performance from each shipment insofar as the surface coating was concerned.

* * *

I imagine that today practically every wire mill in this country is buying the bulk of their lubricants from one of the several commercial manufacturers of this material. These people deserve a great deal of credit for their efforts in the development of the highly efficient lubricants that are now available. By relieving the mills of the increasingly expensive chore of carrying on continuous experiments, of buying and mixing various ingredients in small lots, they have made this into a mutually profitable enterprise.

* * *

INSPECTION is an important and necessary part of the system of control and some observations or tests are made in each department. I have already explained the testing of the green rods prior to patenting.

* * *

SAMPLES for microscopic examination are taken from patented rods and wire at periodic intervals to check structures. It is also a regular procedure to make tensile tests on the first lot of rods run from each new heat of steel. The actual tensiles are checked against the calculations made for that heat by the use of Charts A and B. They usually check remarkably close.

(*Please turn to page* 994)

TABLE I

WIRE SIZE	NO. DRAFTS	TOTAL REDUCTION OF AREA	TYPE OF DRAWING MACHINE	DRAWING SPEEDS IN F.P.M.
.120 & larger	1 to 9	90% Max.	Single Blocks	Approx. 300
.064 to .119	5 to 10	80 to 86%	Continuous	700 to 1000
.011 to .063	7 to 12	75 to 94%	Continuous	1000 to 2000
.010 & smaller	7 to 16	75 to 94%	Continuous	1000 to 3000

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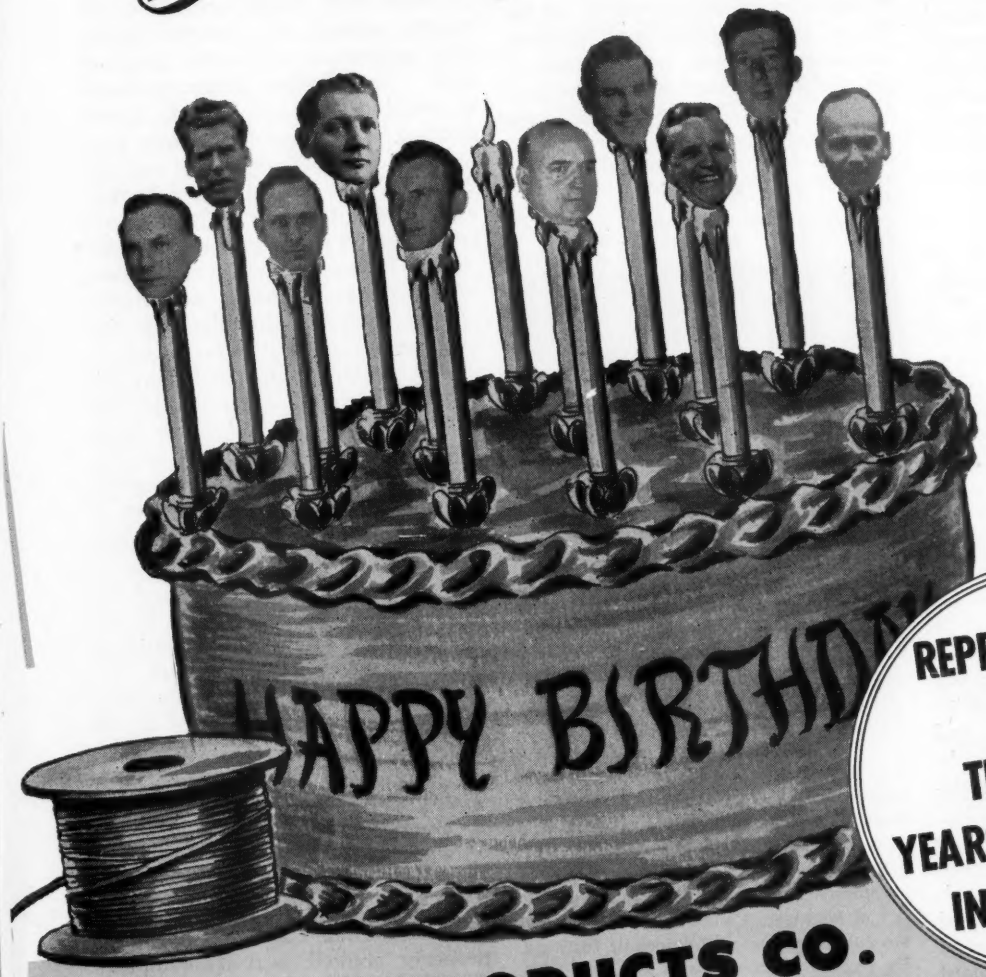

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Practical Development of Modern Wire Drawing Compounds

By E. L. H. Bastian, Lubricants Staff Engineer
Shell Oil Company, Inc.
New York, N. Y.

A discussion of what determines the selection of a proper wire drawing compound for a given job. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

THE old adage regarding "The proof of the pudding . . .", though time worn to the point of being practically a cliché, nevertheless clearly reflects the typical drawing compound experience of most wire mill operators. While ideas, theories, laboratory tests and other experimental techniques have played no small part in the development of modern wire drawing compounds and fluids, the fact remains that the majority of the best commercial compounds in use today have so proven themselves by practical experience.

* * *

FORTUNATELY the process of wire drawing lends itself rather readily to qualifying trials of a compound solution or other fluid. Results may be quickly obtained to determine the usefulness of the fluid. Unlike engine oils, for example, which must be evaluated over long test periods, sometimes in special equipment, in order to determine their over-all suitability for use, drawing fluids demonstrate their operating merit (or lack of merit) very quickly in the wire drawing machine.

* * *

THIS fact has increasingly served to expedite cooperative activity between wire mill operators and compound suppliers in mutually obtaining the benefits of new developments in drawing fluids.

* * *

THERE was a time, well remembered, when each mill and each mill operator possessed and used his own carefully guarded compound formulation. Many of these plant mixed products were similar or closely related. For the requirements of the times they served — and well.

* * *

BUT the passing years brought to the wire industry, as to all industry, new developments, mechanical improvements as answers to old problems, resulting in new production possibilities and also new problems.

* * *

E. L. H. Bastian is Lubricants Staff Engineer for the Shell Oil Company, Inc., New York. After graduating from the Case Institute of Technology in 1931 with a B. S. degree in mechanical engineering, he studied at Wayne University, University of Michigan, Columbia University and the John Huntington Polytechnic Institute. He began his career with Shell in 1936, and has become an authority on fluids and emulsions used in precision metalworking. He is a member of the American Society of Tool Engineers, the American Society for Metals, and the Wire Association.

THIS characteristically organic development of progress in the wire industry is highlighted by several specific events. Perhaps one of the most important of these was the introduction of carbide dies to the industry. Now a common place in wire mill usage, carbides, of course, opened the door to higher wire production and better finished wire. The design advances made in carbide dies since their introduction in better utilizing their production potentialities will not be dwelt on here. It is common knowledge to the industry. The same is true of wire drawing machine design. The use of modern, heavier, vibration-free machines, new methods of materials handling in the mill, metallurgical studies in establishing optimum chemical composition and physical properties in metals used in wire; all these have contributed and continue to contribute substantially toward progress in the industry. By progress I believe we all mean the same thing; better wire at lower cost.

* * *

WELL then, while this is all true, by the word of authorities and your own experience, the question must be strong in your minds — What has all this to do with drawing compounds?

* * *

THE drawing compound or compound solution (in wet wire systems) has about the same relation to the wire mill as blood to the human body, or lubricating oil to your automobile engine. If its there, properly applied, and its composition is suitable to meet the requirements imposed on it, you operate well or poorly dependant upon the degree of suitability of the compound for the particular job requirement.

WE may well ask then what determines this matter of compound suitability for a given job; what are the requirements on the compound; what must it do, and how can we best select, apply and maintain the compound for the results desired.

* * *

IN the first place let's consider the results desired. The most important of these are probably in this order:

1. **Reduction of wire at highest possible drawing speed without interruption.**
2. **Reasonable die life in relation to the wire production obtained.**
3. **The right finish on the drawn wire.**

* * *

THERE are other factors, of course, but these three play the biggest part in securing maximum production, economy and quality. The first and last of these, namely, high rate of continuous reduction and surface finish impose diametrically opposite requirements on the drawing compound or solution, in cases where a bright finish wire is desired.

* * *

THIS is for the reason that the process of reduction and metal deformation of the wire through the die requires the lubricant or solution to lubricate, that is to say, reduce the coefficient of sliding friction and prevent metal-to-metal contact between the wire and die. If the lubricant serves most effectively in this way it also prevents the die from rubbing on the wire and hence does not permit a maximum of polish to be imparted to the wire.

* * *

IF this may seem confusing as a start, let us at least consider that it serves to emphasize the frequent need for compromise in formulating products to be used in a variety of applications.

* * *

IN rod breakdown operations or in finish drawing of wire not requiring a high finish (such as welding rod, for example) of course the lubricant designed for maximum friction reduction is the best. Dry soap, as frequently used in such applications, is a good example.

* * *

IN general, for all classes of wire drawing, the purpose of the compound, lubricant or solution is to do the following:

1. **Facilitate drawing by effectively providing lubrication (reduction of sliding friction) between the wire and die, thus also minimizing power consumption on the machine. The total power requirements in the operation are to plastically deform the metal wire, and to offset frictional losses. These two are about evenly divided in the average installation. However, if no lubricant were employed in the process, frictional losses may run much higher (up to 80%) and in the case of hard or readily work hardening metals result in seizure and fracture of the work material. Obviously the nature of the wire speed of drawing and die material are important in selection of a lubricant to meet specific conditions.**
2. **Prevent welding between the wire and die in the operation, and prevent or minimize metal pickup on the die to facilitate continuous operation, improved die life and desired wire finish. This anti-welding function of the lubricant, where required, sometimes entails incorporation into the compound of chemically active or E. P. additions.**
3. **Cool the drawing dies and wire to optimum equilibrium temperature in the operation at required production speed.**
4. **Maintain reasonable stability in service, resist premature rancidity, separation, decomposition, or odor development, not form objectionable metallic soaps from intimate contact with the work material, and have no objectionable characteristics detrimental to operators' health or safety.**
5. **Be easy to apply and also to clean from the work after drawing. While these two factors are important and have a bearing on the economics of use of the compound, they should not take precedence over product performance, since the latter, by virtue of increased production and other improvements, may frequently more than offset the cost of special cleaning or application methods. Each individual case, of course, must be evaluated on its own merits.**

Development of Drawing Compounds

RECOGNIZING the purposes and requirements of drawing compounds as just noted, and taking into account the fact that different metals pose different problems in wire drawing, let us consider the development of commercial drawing compounds from traditional types (many of which are now and will continue to be used) to newer modern products.

* * *

THE latter have come into being principally to meet new operational needs, new metals and the demand for better performance in older equipment.

* * *

THE primary factors to be considered in determining the suitability of a compound and in making a logical selection are:

1. **Type of metal to be drawn, its normal dry friction properties on the die material, its physicals such as yield point, deformation resistance, rate of work hardening, etc. Also to be considered must be the metal's ability to be wet by the lubricant and nature of possible surface reaction with the components of the lubricant.**
2. **The amount and rate of reduction to be obtained per die in the operation. While obviously it is not expected that stainless steel will permit the same or even similar reduction rates as obtained when drawing copper, for example, various lubricants and drawing solutions demonstrate different ranges of suitability for a given operating condition.**
3. **The die service life desired. This will ordinarily represent a compromise between production requirements and finish requirements.**
4. **The type of finish necessary on the drawn wire.**
5. **Treatment of the wire subsequent to drawing. This takes into account annealing practice, cleaning, and wire coating, such as enameling, for instance.**
6. **Type of equipment and size of wire to be drawn. These two factors are related in that, traditionally, heavy gauge wire and rod are usually drawn on older single hole or two to three draft machines, whereas intermediate and fine gauge wire are always drawn on continuous high speed, multiple die machines utilizing the wet wire method of application.**

* * *

NEW types of continuous high speed machines for heavier rod and wire are, however, coming increasingly into use, particularly in non-ferrous drawing.

* * *

WHEN the above factors are known for a given mill, together with information on supply tank and distribution facilities to the various groups of machines, the selection of the most suitable compound or lubricant is usually well defined.

Types of Wire Drawing Compounds and Lubricants

THERE are essentially three classes of lubricant used in the drawing of wire, both ferrous and nonferrous. These are:

1. **Dry soap compounds, used neat in a box ahead of the die, usually in single**

hole or two and three draft machines on ferrous wire of heavy gauge. Dry sodium soap is an effective lubricant in reducing friction and power consumption on the machine. The application is simple and has advantages. However, by virtue of its effectiveness as a lubricant in adhering to the metal surface and preventing die contact, it ordinarily is lacking in producing good finish on the wire. In addition, it is often difficult to remove in cleaning, and may cause annealing troubles. On some machines, also, the arrangement of the soap box is convenient to the operators.

Dry soap, while a good lubricant, has neither the chemical effectiveness of E.P. agents to prevent a buildup of frictional heat nor the physical cooling abilities of a water solution. Hence in high speed wire drawing, wet wire methods are used, since dry soap at high die temperatures would char and be useless. This brings us to the second class of wire drawing lubricant.

2. Wet wire solutions or emulsions made by mixing compounds (usually paste type) with water in various concentrations. These compounds are usually mixtures of fats, fatty oils and acids, soaps, water and sometimes mineral oils, sulphonated oils, germicides and chemically active additives to impart specific anti-welding or wetting properties to the solution. Volumes could be discussed on this class of product regarding the use and relative merits of many components tried. These compounds (in emulsion form) are used principally in the high speed drawing of carbon steel, copper and brass wire. Soaps generally used are either sodium, potassium or aluminum. Typical fatty constituents are tallow, lard oil, degras, palm oil, rapeseed oil, tall or hydrogenated oils. Fatty acid content is usually controlled to limits for the type of metal being drawn. Steel wire compounds may contain up to 2.5 - 3% free fatty acid whereas compounds used in copper and copper alloy wire drawing are held to about 0.5 - 0.75% free fatty acid maximum. This is to minimize formation of copper soaps (green scum) which would otherwise occur by combination of the free fatty acid with copper fines in the system. Frequently inhibitors are also put in copper wire drawing compounds to further preclude such copper soap formation which is abrasive to dies, and would result in premature die wear if allowed to accumulate.

   This represents just one point of difference between compounds used for steel wire and such non-ferrous wire as copper. Since there are other differences both in formulation and methods of preparation, as well as special cases, both ferrous and nonferrous, it will probably be desirable in the interest of clearness, to discuss wet wire compounds in further detail under headings of metals drawn. Before doing so, however, let us mention the third class of drawing lubricant used in the industry.

3. Drawing oils, representing various types of compounded mineral oils and other fluids, are being increasingly used for drawing such metals as stainless steel and aluminum. This is a relatively new field but growing rapidly based on industry demand for stainless steel and aluminum wire. Due to this demand and the currrent relation of supply position on nonferrous metals, many copper wire mills are now producing aluminum wire in the same type of drawing equipment and at comparable speeds for given size wire.

   Both aluminum and stainless steel, while widely different in physical properties and end use, have this point in common as a problem to the wire mill operator. Their surface characteristics are such as to resist the lubricant wetting or forming an adherent film. For this reason, among others, the conventional soap-fat emulsions are not usually adequate as drawing solutions. The most promising results to date are obtained with oil type fluids.

* * *

THERE are other classes of materials than the above-mentioned three which are used for drawing, and in some cases for wire drawing. These include the use of grease, oxide coatings (as in sulling of ferrous wire) and soft metallic coatings (tin, lead, zinc and copper) being applied by hot dipping, electroplating or solution dip coating as in "copper-coating" of steel wire, for example.

* * *

LUBRICANTS containing inorganic pigment fillers such as lithopone, chalk, clay, talc, mica and graphite are often used in tube or press drawing, but rarely in wire drawing since in wet wire circulation systems such components would settle out in piping bends, screens and horizontal lines resulting in objectionable buildup, and clogging the system when machines were shut down.

* * *

NOW let us consider wire drawing lubricants by the type of metals being drawn, which thus takes into account the effect of both mechanical and metallurgical factors (previously discussed) on the formulation and use of the drawing lubricant.

Ferrous Wire Drawing
Carbon Steel

CARBON steel wire may be drawn by use of dry soap, grease or wet wire circulating methods of lubrication. "Sulling" (hydrated oxide coating) and liming, in conjunction with dry soap drawing of welding rod, fence wire, etc., is a common practice. The soap used is generally a sodium soap for best results. This process may also be used on carbon steel wire preparatory to further reduction by the wet wire method through continuous multiple die machines.

* * *

ORDINARY calcium base grease or a potassium soap with small addition of fatty oil is often used on single hole drawing of bright wire. The lubricant is packed in a box ahead of the die. In the same manner, calcium grease or a regular soap-fat paste compound may be mixed with lime and used in grease boxes ahead of the dies in two, three and four-hole machines.

* * *

IN wet wire drawing of carbon steel, drawing compounds containing soaps (usually sodium or sodium-potassium combinations) and a relatively high fat content (about 40-50%) are mixed with water to secure a soap-fat concentration of from 1.5-3.0% for use. The bulk temperature of the solution thus obtained, and circulated through the dies, is usually about 120-150°F.

* * *

DRAWING speeds on carbon steel wire vary from 200-300 feet per minute for dry soap and grease box reduction of heavy rod up to as high as 2,000 feet per minute for wet wire drawing of fine wire in continuous machines. Generally, a medium to high titre fat is employed in wet wire compounds used for steel wire drawing.

* * *

THE same type of wet wire compound may be used for all sizes of carbon steel wire drawn with standard die angles and reductions. Both high and low carbon wire are satisfactorily drawn with such compounds by varying the soap-fat concentration in the solution. For the same concentration, a solution containing a high proportion of free fat and/or free fatty acid in general provides better lubrication and die life, whereas a solution higher in soap content and low in free

fatty acid provides better wire finish due to burnishing action of the die on the wire.

* * *

SOMETIMES, where lime coating is employed, there may be a so-called "soaping out" effect due to combining of excess free fat or fatty acid in the solution with lime from the wire. This results in formation of insoluble soaps which may clog the circulating system and cause trouble. The remedy is to reduce the free fat content in the compound in relation to soap content but not to an extent to induce the foaming characteristic of too high soap concentration solutions.

* * *

FREQUENTLY, to prevent this latter difficulty, special types of soap are used. These, in combination with the minimum free fat necessary for lubrication perform best in drawing limed steel wire.

* * *

VARIOUS soft metal coatings are sometimes used on steel wire dependent upon intended end use of the finished wire. Such metals may be tin, lead, copper or zinc. Tinning and copper coating of wire are common practice, as is galvanizing. In a typical instance of the latter practice, steel rod is drawn down to about 0.070 inches, then galvanized and further reduced to 0.012 inches. The soft metal coating in every instance serves to facilitate drawing of the wire. The same type of wet wire compound is used as in bright wire production.

* * *

FOR fine steel wire drawing (below about 0.050-0.060 inches) leaner emulsion concentrations (about 1.5-1.75% soap-fat) are best utilized, particularly on bright wire.

Stainless Steel Wire Drawing

THE drawing of stainless steel in any form represents a special problem due to metallurgical considerations (surface effects, work hardening rate of stainless, etc.). This problem is not as acute in wire drawing as in some other processes (such as tube drawing, for example) but still requires special handling, generally lower drawing speeds and the use of specially formulated drawing compounds, oils and solutions.

* * *

AN additional problem is created where bright finish is also necessary on heavy gauge wire such as in wire to be used in refrigerator racks, for example. Here, a bright finish is necessary on 3/16 inch or heavier wire. At the same time reasonable drawing speed and die life are desired in the interest of operating economies.

* * *

THERE are two general classes of lubricant used in commercially drawing stainless steel wire. These are water soluble products in solution or emulsion form, and secondly, drawing oils.

* * *

THE latter are usually specially compounded mineral oils containing either or both soaps and chemically active constituents having high E. P. characteristics, such as chlorinated compounds. Some types of active cutting oils, also containing fats or fatty acids have been satisfactorily used for drawing heavy stainless wire at low speeds. Viscosities of oils used may vary from S.S.U. 200 to 3,500 at 100°F. They are used in the neat form and are generally suitable only for gauges heavier than about B. and S. #30. In single hole and two or three draft machines the heavier viscosity oils are applied by grease box ahead of the die.

* * *

OILS of lighter viscosity (200-700 S.S.U. @ 100°F.) can be circulated in continuous multiple die machines but in any case, drawing speeds must be reduced in order to minimize excessive heating and smoking of the oil. Bulk temperatures should be maintained at 150-160°F. maximum. Oils, of course, do not provide the physical cooling by circulation characteristic of water solutions or emulsions.

* * *

THE latter are and may be used in continuous machines for drawing fine stainless steel wire, but with some sacrifice in die life, dependent of course upon die selection and drawing speeds. B. and S. gauges #30-42 are thus drawn. On fine wire (such as magnetic recorder wire) diamond dies are often used.

* * *

PASTE type soluble compounds in about 3% solids concentration in the solution or emulsion are used with reasonable success. These compounds may contain wax type constituents, chemically active ingredients, soaps, some fatty oils and usually high free fatty acids.

* * *

HOWEVER, drawing oils, as first described, appear more promising, generally, for stainless steel wire drawing than the water mixed compounds. In a recent typical instance, the replacement of a water emulsion with drawing oil in a machine using diamond dies resulted in 20% better surface finish and much improved die life.

Copper and Brass Wire Drawing

COPPER and brass wire drawing is done almost entirely by wet wire methods utilizing a compound solution or emulsion. On rod breakdown operations, however, the heavy starting size rod is sometimes passed through a box containing tallow or neat compound before entering the first die.

* * *

THERE is a wide diversity of soap-fat concentrations used in emulsions on this class of work dependent upon wire size, reduction rate, drawing speed and finish desired.

* * *

THE compound used for rod breakdown and intermediate draws (down to B. and S. gauge #30 approximately) is usually a combination of potassium soaps and free fat (often tallow) in conjunction with water. Free fatty acid in all good copper drawing compounds should be low in order to minimize formation of copper soaps (green scum) in the system.

* * *

CONVENTIONAL practice is to use about 4-6% soap fat concentration in the fluid maintained at a bulk temperature of 140-160° F. Drawing speeds for rod breakdown operation vary somewhat dependent upon design of machines used. Current practice in new ma-

chines permits speeds up to about 3000 feet per minute for copper.

* * *

FOR intermediate draws on copper and brass, a soap fat concentration of 2-3% in the emulsion and bulk temperature of about 110-130°F. are usually maintained for good results. The same type of compound is used as for rod breakdown. The neat compound should preferably have a low free fatty acid (about 0.75-1.0% maximum) and may also contain an inhibitor to minimize or prevent formation of abrasive copper soaps previously described.

* * *

INTERMEDIATE drawing speeds range up to about 4,000 feet per minute in current practice on new design machines. In one large modern plant speeds up to 5,000 feet per minute are used on wire drawn to B. and S. gauge #14. On finer wire (to B. and S. gauge #28) even higher speeds are used. In such high speed operation some precaution must be taken to avoid excessive foaming of the emulsion in the system. This can be handled adequately by proper compound formulation and concentration control in the system.

* * *

FINE copper wire drawing (B. and S. gauges #30-46) usually requires a somewhat different compound than is used for heavier gauges and a much more dilute emulsion. The compound should contain a high proportion of soap and low fat. Too much fat in a fine wire solution used in high speed drawing may cause "sticky" wire, "wrapping", and wire breakage.

* * *

IN using high soap compounds, however, some caution must be taken against foaming. This problem is made even more acute because of higher and higher fine wire drawing speeds. These may range on the order of 5,000 to even as high as 10,000 feet per minute. To get best results under these conditions, as dilute a solids concentration in the solution as possible is desirable. This may be 0.5-1.5% soap-fat solids. Bulk temperature of the system is usually maintained at about 90-110°F.

* * *

NEW liquid type compounds are now being introduced for fine copper wire drawing at high speeds. These are water miscible products of special composition which appear very promising at present in doing the job with minimum foaming and good die life. About 1 to 2% concentrations of the oil in water are being used for current trials.

* * *

PHOSPHOR bronze, cupro-nickel and other high tensile copper alloys are also drawn in wire forms. In most instances these can be drawn with the usual brass drawing compounds or with slight modification of these materials.

Aluminum Wire Drawing

THE drawing of aluminum wire is coming into increased prominence in many mills. It is drawn in the same equipment as used for copper and brass wire and in many cases at comparable speeds for given size wire.

* * *

THERE are two general classes of lubricant being used commercially for this work: neat oils, and emulsions made up from compounded oils. The latter, where used in wet circulation over the dies, is usually supplemented by previous application of the neat oil to coils of the wire to be drawn.

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IN a typical instance of such successful application the procedure and operations are as follows:

* * *

BEFORE drawing, the neat compounded oil (a fortified water soluble type containing certain chemically active and fatty agents in adidtion to emulsifiers)• is first sprayed onto the wire, providing an oily coating. The wire is then drawn in a continuous multiple die machine in which is circulated an emulsion of one part oil and ten to fifteen parts water. The reduction obtained is from 0.060 inches down to 0.0126 inches in twelve passes through carbide dies. Finish, production and die life are all reported to be good in this operation at about 2,000 feet per minute speed.

* * *

THE principal lubricant used in aluminum wire drawing to date, however, is a compounded mineral oil. This may contain emulsifiers to render easy subsequent cleaning in water or water solutions. The compounding used in the oil usually contains some fatty oils and fatty acids. The viscosity of finished oil may vary from S.S.U. 100-200 @ 100°F. up to 3,500 @ 100°F. The lighter viscosities are used on finer wire at high speeds and the heavier oils on large gauge wire and rod at lower speeds. A typical case of the latter is reduction of ⅜ inch rod down to 0.12 inches in eight draws using a 2,000 second oil at bulk oil temperature of 170-175°F.

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THE chief difficulty with oil, however, is a thickening up in service at a rapid rate. This tendency is made more acute by the accumulative buildup of aluminum fines (due probably to formation of soaps from free fatty acids present) in the oil.

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BY suitable dilution with a lighter oil this problem has been overcome in some cases. It is desirable to use as low a viscosity oil at the start as will do the job, and to maintain bulk temperature of the oil at about 150°F. maximum to get the best results. Oil, of course, does not have the cooling properties of water solutions or emulsion. Hence, a larger volume of oil must be used and circulated and some means of additional cooling provided. This can be arranged by use of cooling coils in the oil or some other heat exchanger installation.

* * *

A compounded water soluble oil having S.S.U. viscosity of 350 @ 100°F. is used neat by one mill for drawing aluminum cable wire at 1,000 feet per minute. Operation and finished wire meet all requirements and no difficulties are encountered with the oil. Being water soluble it is readily cleaned from the wire.

Conclusion — General

THE comments just made regarding drawing operations, speeds, types of compounds, oils and solu-

(*Please turn to page* 962)

Fumes and Ventilation in the Wire Mill

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A discussion of the problems involved in the study of the fumes developed in Wire Mill operations. Some suggestions are made for proper ventilation. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

The Ever Increasing Pressure of Civilization

THERE was a time when most any person on earth could do almost anything he wanted to without infringing on the rights of others. Modern civilization with its teeming millions concentrated close together on fifty-foot lots of modern cities has changed all that; and modern industry with its mass production is feeling the pressure more and more, to include the controlling of its manufacturing by-products and wastes in the costs of production. More and more cities are passing drastic laws to stop the unlimited dumping of waste acids, alkalies, and chemicals into the rivers contaminating the drinking water of millions living in cities, and pouring out fumes, vapors, smokes, and gases polluting the air they breath, and destroying the homes, vegetation, and property of those living in the vicinity of industrial plants.

The Wide Scope of Industrial Destruction

IN a beautiful little community in upstate New York the hydrofluoric acid fumes from the pickling department of a large plant completely frosted all the windows in homes, and in its own office building that was located two blocks away, to the west of the plant. A plant in Buffalo, New York, poured out soot and dirt over the entire neighborhood for blocks around and ruined the freshly washed clothes of the house-wives every Monday and Tuesday morning, so that they finally formed a committee and went to court to stop the company from pouring smoke and dirt over their clean clothes. In another city over $200,000 worth of new concrete sewer pipe was destroyed in a very short time due to dumping waste pickle liquors into the city sewers. In still another plant a vicious strike and much labor trouble was caused during the war because of poor working conditions from fumes and heat causing much sickness and a very large amount of lost time for the men. As the climax and a final example, in a Baltimore plant that was poorly ventilated a pickler was overcome by the heat, humidity, and fumes in the pickling department, and when he "blacked out" he plunged into the tank of boiling acid, and was scalded to death. The contamination of city waters from rivers in industrial areas costs millions in water treatment, and in the destruction of hot water tanks in homes that obtain the water from these polluted streams. The life in these streams has disappeared long ago.

A Vast Amount of Knowledge Required To Solve the Problem

BECAUSE the problems involved are so many, and of such enormous size, a vast amount of knowledge is required to solve them. Many large cities like Pittsburgh, Cincinnati, St. Louis, Los Angeles, and others have already extensive programs of research and control in operation; industries are fast becoming interested in the control of their smokes, fumes, gases, and liquid wastes because of the drastic laws being drawn up in many cities to stop the destruction caused by these industrial wastes. The one bright spot is that the pressure involved sets into motion forces that increase the knowledge of all industrial processes by research and intelligent studies of the individual problems, and this eventually is reflected in decreased costs of production, and more efficient operating conditions, which of course also greatly benefit industry as a whole. Our specific problem for discussion at this time is, **"Fumes and Ventilation of Wire Mills".**

A Broad Survey of the Problem

A comprehensive discussion of the problem that can be used as a guide for all wire mills, requires that the problem be broken down in a systematic manner, and each phase and condition studied in an orderly manner. Immediately we are faced with two fundamental conditions, namely, all the factors and components on the outside of the wire mill, and all of the factors and components present on the in-

side of the wire mill. Things on the outside affect those on the inside; and things on the inside affect those on the outside.

(a) Outside Components:

THE most important outside component is to be found in the homes, the gardens, and the people that live in the homes, in the immediate vicinity of the mill. This can be boiled down to the expression — "other people, and other people's property.

* * *

THE second important fact to be considered at once is the location of the mill; what part of the country is it in, north, south, east, or west; the climate has an important bearing on fumes, and fume conditions. Is it located in the city proper, the city outskirts, or in the country? Is it located on a river bank, in a valley, on a hilltop, or a mountain? Is it inland, or on the coast? Is it surrounded by other buildings and industrial plants and factories, or does it sit out in the open? What are the wind, rain, fog, and snow conditions? Is it in a dry climate like Arizona and other western locations, or is the location one of considerable changes of temperature and humidity? All of these outside factors and conditions are of interest.

(b) Inside Components:

THE most important inside component is the human element, for upon men and their labor, working conditions, their skill, and the machines and equipment in their hands, is a high or low production, high or low costs, and the difference between profit and loss.

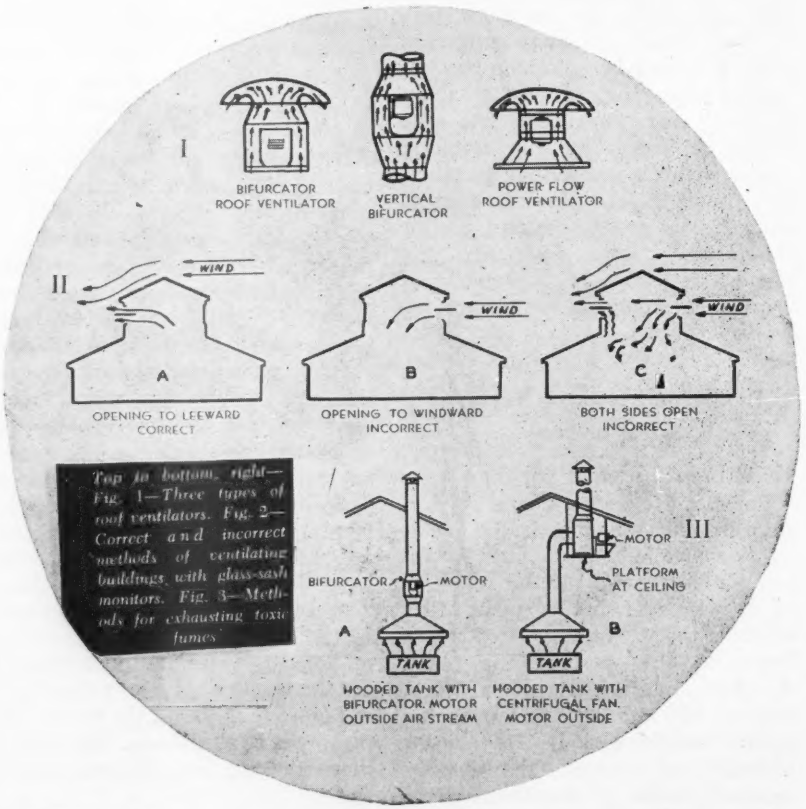
* * *

THE second important inside condition is dependent upon the link between the outside and the inside components, namely, the design of the building itself. Steel mill buildings vary considerably in design, in size, in length, width, and height, in the type of roof, in louvres, windows, doors, and ventilators. The building itself is the link between the outside and inside.

THE third important inside condition is what equipment, and what operations are in the building? The machines, the equipment, and the operations result in fumes, heat, gases, noise, and many other factors that affect the health, and the physical condition of the workers. The humidity and heat are especially important; the air they breath should be clean air, not contaminated with heat, acid fumes, gases, or other fumes. The cranes and overhead structures are extremely important factors; what kind of equipment is used, and where it is located, and how it is operated are involved in the problem; the space or area to be heated and ventilated; the segregation of machines of one type in one place and another type in another spot; the volume of air change required; the affect of open doors, windows, and cross drafts; the type of ventilating equipment used; the type of heating equipment; all of these conditions are involved in the proper solution of the problem.

Where Is The Start

THE question is **"where do you start to solve such a complicated and involved problem?"** The start is in subdividing all the problems into separate individual problems, and then concentrating on each individual problem one at a time. It would appear that the satisfactory solution is found in — 1. In collecting all fumes, heat, gases, etc. into one main place; washing and purifying the gases and fumes with water sprays, and turning the clean pure air loose again to the atmosphere, or making a connection down into the sewer lines. 2. The sewer lines take the waste acids, wastes from the alkali cleaning tanks, and all waters of that type, treat them by one of the best methods of neutralizing and rendering the fluids harmless, and then turn the harmless wastes into the city sewers, or drainage facilities to the river after meeting the requirements specified in ordinances etc. by the community. To briefly



Figures 1, 2, 3. * * * * * *

Fig. 4.—Power flow roof ventilators. Top of ventilator tilts and locks in position for access to motor.

Fig. 5.—Two-forked type ventilator for removing air above 150 degrees.

Fig. 6.—Low-floor open-hearth building equipped with two types of ventilators.

Fig. 7.—Application of individual hoods, ducts and bifurcator for removing high temperature air from heat treating department.

Fig. 8.—High-temperature bifurcator for handling 800-octane gases.

Fig. 9.—Application of principle of trapping heat directly at source:

state the problem then it is one to catch, control, and clean all fumes and contaminated gases and air, wash them thoroughly and send them out along with the properly treated waste liquors and rinse waters etc. in a harmless condition into the sewers, after they meet the required ordinances of such disposal of commercial wastes.

* * *

THE next step is a problem of engineering; the question of **open** or **closed** systems of handling and control. As a typical illustration of the requirements here it is of interest to recall the complete failure of a company in removing fumes. The company employed one of the best known ventilating companies in the country on the basis, that they accept the contract that if they succeeded they got paid; if they failed, it was their loss. That was the agreement. A ball ventilator was placed on the roof; then two, then three, then five, and finally the whole top of the roof was covered with ventilators; it was said there were 46 in all. After at least a year of trying, the company gave it up as a complete failure, and the company guaranteeing successful removal of the fumes had to pay for the venture. The reason they failed was because they did not understand the basic principles involved.

* * *

THE question is — **"What do we mean by an open or closed system?"** That can best be illustrated by visualizing the exact conditions of the ordinary soft coal hot air heating furnace in the cellar. That is a unit; and the system is completely closed. The fire burns in the furnace bowl; the smoke is confined and held in the furnace; the unburned and burned fuel-gases and smoke go up the chimney and out the chimney at the roof. The unit is entirely closed, and the air in the cellar is clean, clear air. Now suppose that the connecting chimney pipe from the furnace to the chimney is removed, or falls down; that then immediately changes the system from a closed system to an open system, and smoke pours out into the cellar. Maybe the cellar windows are open and the smoke pours out, and the owner

is clearly aware that the remedy is to put the smoke back in the furnace, and once again set up a closed system. That simple illustration I am sure is clear to everyone. Well exactly the same principles are involved in a wire mill; each individual furnace; each tank; each separate fume making piece of equipment must be made a closed system; that takes care of the fumes from each unit. Finally the building itself is only a very large unit and it too must be made a tight closed unit. So here is another vital principle that is involved in successful handling and ventilating a wire mill. To summarize the principles involved there must be — 1. Unit closed systems for each piece of equipment sending off heat, acid fumes, or gases; and 2. The building itself must be visualized as a closed unit, and then engineering equipment set up for the proper ventilation of the building. Open doors, windows, cross-drafts, etc. set up a broken system; it must be a closed system.

Window Ventilators in Louvre

MANY buildings are designed with the window ventilators in the louvre. To properly ventilate with this type of equipment requires at least two definite things, namely, to know in which direction the wind is blowing; and 2. To understand how to operate the window openings so that the wind, or air-suction will drag out the air in the building. Suppose the wind is from the north, and blowing directly south, with a louvre running east and west. If both the north and south louvre windows are opened then the wind just blows in through the north windows and out through the south windows. If the line of windows on the south are closed the wind blows down into the plant from the north, and that does not properly remove either fumes or air. The proper way is to open the south line of window ventilators and close the north windows. The wind rushing over the top creates a suction and draws the air out of the building. But that still does not solve the fume problem, nor give proper ventilation. The entire building is always filled full of foul air and air that is contaminated with fumes, heat, gases, and all vapors in the building. The affect of such a building design is to just dilute the atmosphere in the building to a condition that the men can stand without complaining. It is therefore only a partial, and at best a poor attempt to solve the problem.

Problems Involved in Setting Up Closed Unit Systems

THERE are two closed systems to be considered in the problem of fumes and ventilation of wire mills. The first is the building itself. There are doors, windows, ventilators, and openings that tend to act like check valves, or check dampers, and thus prevent the building from being a tight closed system. The building should be as nearly a closed system as is humanly possible to make it so. The problem of ventilating engineering, and heating the building is made much simpler and more efficient the nearer the building is to being a closed system. The second closed system is made up of all the various items of equipment used in the manufacturing operatings. Annealing furnaces, pickling tanks, galvanizing furnaces, and every single piece of equipment that is a source of heat, acid fumes, galvanizing fumes, oxide fumes, or any kind of fumes that are to be controlled. The problems involved in setting up the proper hoods, ducts, fans, etc., for the individual units systems are far more difficult and complicated than the solving of the heating and ventilating problems. This is because of overhead cranes that must be continually in motion serving production needs; there are also beams, girders, and tierods, and other obstructions in the way, and the most difficult problem of all is to set up hoods, ducts, etc. that will not hinder normal operations, or slow down production. Individual unit systems may also be divided into two distinct phases of engineering practice in handling fumes, heat, etc. The first is the direct, enclosed overhead hood system which is a tight completely enclosed system for each unit; the second, is the side, or top duct system in which the fumes are sucked from the surface down into ducts around the equipment, and down into the main ducts down in the floor, and then out. We might add a third unit system and call it the completely covered system. Such a system of tight covers is used in the Ford plant over their continuous pickling line, and also in the continuous strip mills.

Reduction and Control of Fumes by Chemical Means

THE early operating pickling and galvanizing methods used pickling tanks of sulphuric and muriatic acids that were heated with open

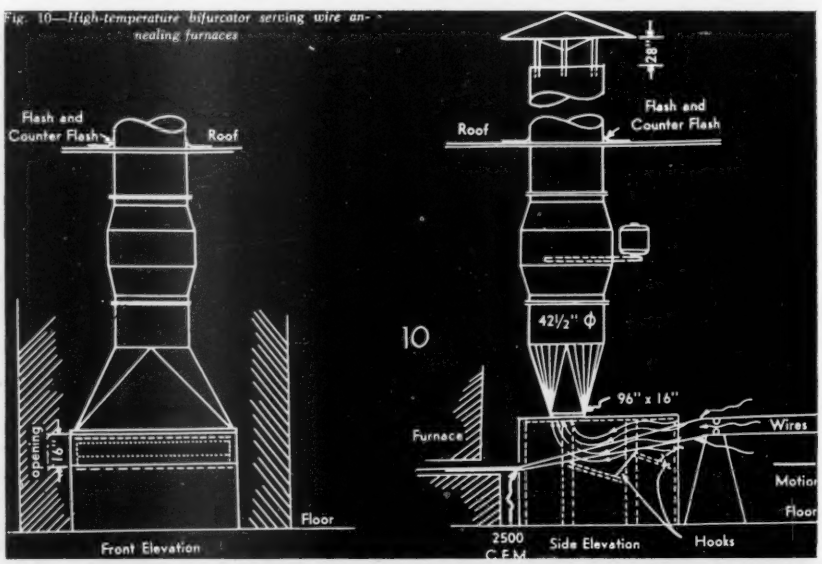


Fig. 10—*High-temperature bifurcator serving wire annealing furnaces*

steam lines. Steam vapors, acid vapors, and fog and mist filled the pickling departments. In one plant the fumes and fog were so thick that the operator could not see a distance of ten feet ahead of him; in another plant the operators bound their heads up in rags to stop the acid fumes from "biting" their faces and neck; in still another the choking muriatic acid fumes kept the operators continually coughing, and persons not used to such conditions simply could not stay in the room at all. In still another plant the hot steam vapor kept the pickling room so humid that on a hot July day one of the picklers "blacked out" and fell into an acid tank. In the early days of galvanizing when sal ammoniac salt was used as a flux material for on the galvanizing baths the heavy white and blue fumes poured up from the pot during operations. In one plant the pot fumes were so bad that the men lost at least one day a week from colds and sickness, and one of them almost died of pneumonia. Stripping tanks are particularly vicious from the acid fumes given off. Modern chemicals called "Inhibitors" and "Foam Blankets" are now available to use both in the pickling solution and over its surface to reduce and eliminate most of the vicious acid fumes from pickling, and hold down the steam vapors. The change from the old sal ammoniac salt to the new modern liquid flux technique has greatly reduced the pot fumes in galvanizing operations. Modern chemicals now are an extremely important factor in the reduction of fumes in cleaning, pickling, and galvanizing.

Each Phase a Separate Engineering Problem

PROGRESS can be made in solving the fume and ventilation problem of wire mills if each phase is studied as a separate engineering problem. The enclosed unit system of control is the starting point. How shall each unit be hooded, and what fume is to be controlled. What are the vapors, fumes, heat, gases, etc. made? What operations make them? Each operation must be thoroughly studied, and the engineering skill comes in making the unit a closed system for the removal of heat, fumes, steam vapors, etc. Wherever the tanks, furnaces, or fume or heat making equipment is located, or segregated, those areas must be studied and handled as a unit.

* * *

THE second absolutely separate phase is the engineering problem of proper ventilation of the building. With the fumes and heat, steam vapors, etc. in a tightly enclosed system on each unit, the air should now be fairly clear, and clean. But there may be large areas sending out very large volumes of heat, so that now we have the additional factors of humidity and temperature to deal with. Here is where the height of the building, the kind of top structure, the louvres, and design of the building play an extremely important part. An extremely interesting problem came up in one plant in trying to solve the ventilation problem. Power fans were placed in the roof, and so much air was changed, that the upward suction of the ventilating equipment was greater than the stack pull on the galvanizing furnace, and the by-products of combustion from the fuel burned to

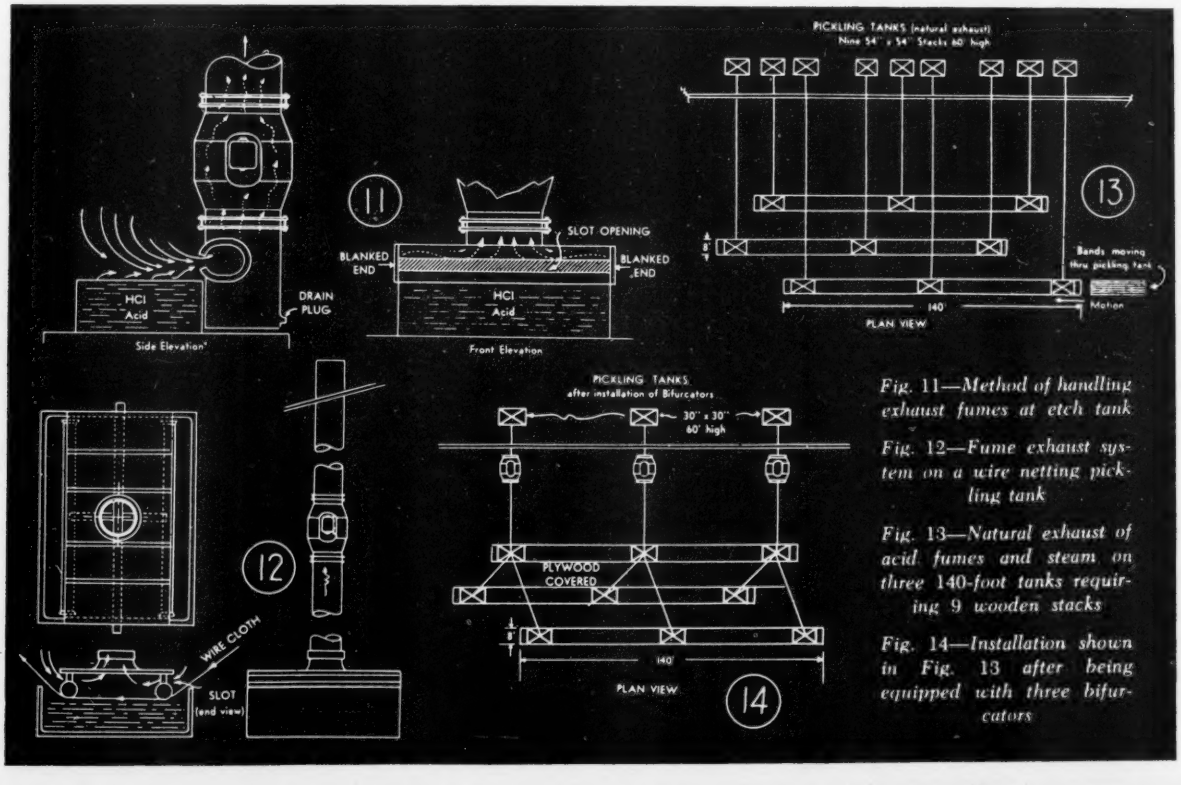


Fig. 11—Method of handling exhaust fumes at etch tank

Fig. 12—Fume exhaust system on a wire netting pickling tank

Fig. 13—Natural exhaust of acid fumes and steam on three 140-foot tanks requiring 9 wooden stacks

Fig. 14—Installation shown in Fig. 13 after being equipped with three bifurcators

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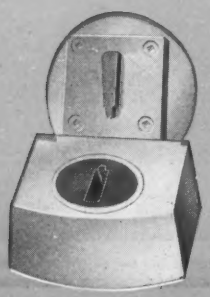

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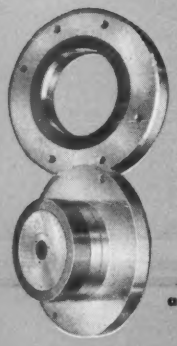

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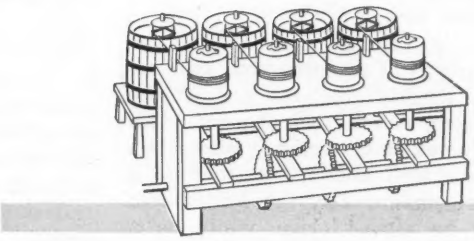

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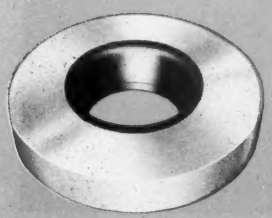

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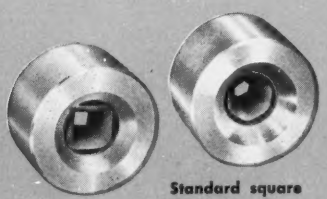

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heat the furnace were drawn right out into the open room space instead of going up the galvanizing furnace chimney. So here we have a very definite problem of determining the proper volumes of air to be changed. The problem of ventilation is a problem of air change, and must be studied as a separate phase.

The Heating Problem

IT has been mentioned before that temperature and humidity play a very important part in the fume problem. In the East where the winters are cold, severe, and there are big changes in temperature, heating is of interest from two angles, namely, the comfort of the workers, and second, the reduction of fumes, fog, steam vapors, etc. It is a well known fact that on a warm summer day the atmosphere may be almost clear, while on a fall day, with high humidity, or rain or snow, the fumes may be very bad. So it is very important to check the temperature and humidity when the fumes are worst, and when there is a comparatively clear air. Then the heating problem becomes one of duplicating the temperature at which the least fumes were produced. There is a very distinct and complicated engineering problem involved in the proper heating of the wire mill. There are many types and kinds of both heating and ventilating equipment, and as already shown in the illustration

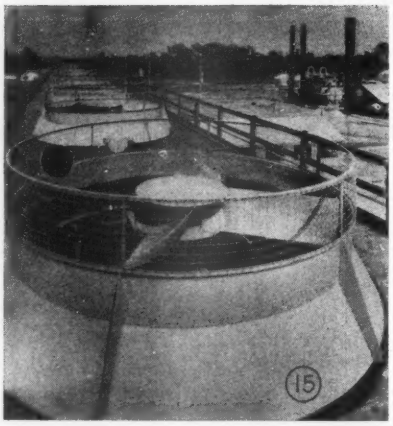

Fig. 15. — Induced draft water cooling tower (Payne photo). * * * *

of the failure with many ball ventilators, the equipment may be excellent, and the failure caused by not understanding the engineering problems which involve the proper location of the equipment, the proper sizes of equipment, and the application of the proper engineering principles.

Engineering Requirements

EVER since there has been an iron industry, those working in it have been plagued with heat and fumes. So the first consideration must be taken from the human standpoint. The wire mill could not operate without men (labor), and the working conditions are a very vital factor of costs, since the health of the workers, their mental and physical condition, and their attitude are all a basic factor of production results. One company found that their accidents were greatly reduced by allowing a short rest period and supplying milk. There are many angles therefore involved in the problems of fumes and ventilation. It would appear that modern engineering should consider two phases of the fume problem, namely, first, the inside angle second, the outside angle, as to how they affect the air and atmosphere the people must breath in the city and community where the mill is located, and the damage done to property belonging to people living in and around the mill area. The modern engineering conception therefore visualizes all fumes, acid vapors, etc., caught immediately at their source of production inside, conveyed to a central point of treating and washing, after which the clean air is sent out into open atmosphere, and the washing liquids sent into a sewer to neutralizing and treating tanks along with the waste pickle liquors where all are rendered absolutely harmless, and the discharged waste nothing but clear, harmless water. Thus both fumes and waste liquors are treated; the one to clear the atmosphere and establish the best working conditions inside the plant, and the other to treat and neutralize all waste liquors so that they do not

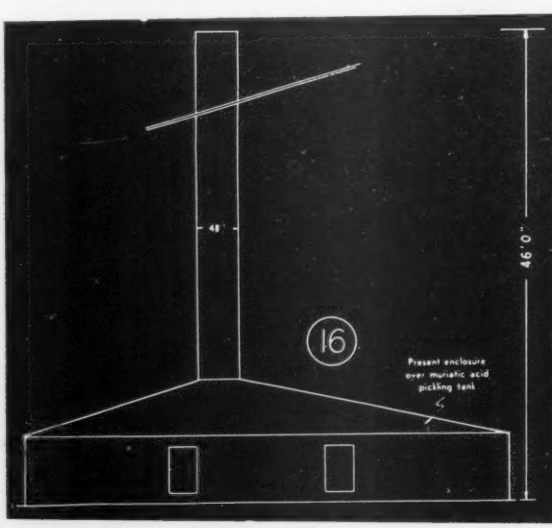

Fig. 16. — Simple exhaust system for 40-foot acid tank. * * * * *

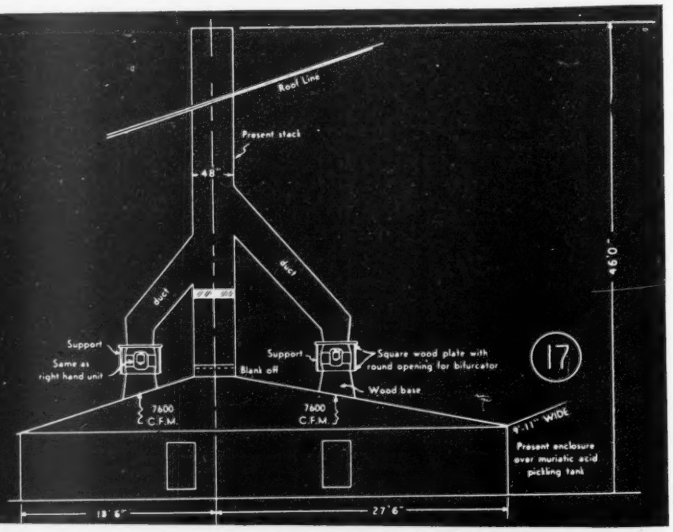

Fig. 17. — Pickling installation shown in Fig. 16 but with exhaust system redesigned with dual bifurcators. * * * * * *

contaminate rivers and drinking water; the first to avoid the smokes, over cities; the second, to protect the sewers and drainage systems from corrosion by waste acids, and the pollution of the rivers that furnish water for the inhabitants of cities to drink.

No General Solution Possible

THERE is no general solution that will definitely solve the fume and ventilation problem of all wire mills. Each plant has its own local conditions which must be studied, controlling the fumes, and supplying the proper ventilation is a matter of applying the correct engineering principles to solve the problem at hand. The choice of the type of the equipment, the kind of equipment, and the proper location and installation depends entirely on the skill and understanding that the engineers have of the problem in front of them. It is not possible in a paper of this type to give a definite solution of the problem; the idea and purpose of the paper is to unfold how the problem must be approached, and to submit an orderly and systematic outline of the various separate phases involved in the proper solution of the problem. It is always cheaper, and costs are always lowest when things are done correctly. It is perhaps a new approach to the problem of fumes, ventilation, and handling of all industrial by-products, to consider the cost of handling and treating these by-products satisfactorily, as a definite production cost that should be included in the manufacturing cost of all products that produce by-products which entail an additional cost of treating them to make them harmless to both the inside working personnel from all angles, and from the standpoint of polluting the atmosphere that people breath, the river waters that they drink, and damaging the property they live in, not to mention the thousands of dollars that are incidental, such as repainting, laundry costs, wear and tear from excessive dirt, such as comes from soot, smog, and smokes, and damage done to windows, vegetation, etc. where large volumes of acid fumes from pickling operations are sent out into the air to be blown over the nearby homes and property in the vicinity of the mill.

* * *

The writer wishes to express his great appreciation and thanks to Mr. A. M. Harp, DeBothezat Fans Division, American Machine and Metals, Inc., East Moline, Illinois, for technical Bulletins with information on ventilation of steel mills, and the excellent Figures and illustrations used by Mr. G. E. Wallin in his excellent series of articles "Ventilation for Steel Mill Buildings".

* * *

The following other equiment companies also sent the writer their catalogs, bulletins, and technical information for which the writer also wishes to acknowledge with thanks and appreciation.

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Buffalo Forge Company, Buffalo, N.Y.
The R. C. Mahon Company, Detroit, Michigan.
American Blower Corporation, Detroit, Michigan.
The New York Blower Company, Chicago, Illinois.
Propellair, Inc., Springfield, Ohio.
Hartzell Propeller Fan Company, Piqua, Ohio.
Autovent Fan and Blower Division, The Herman Nelson Corporation, Chicago, Illinois.
The Allen Corporation, Detroit, Michigan.
The Kirk & Blum Manufacturing Co., Cincinnati, Ohio.
Haveg Corporation, Newark, Delaware.
The G. C. Breidert Co., Los Angeles, California.
Surface Combustion Corporation, Toledo, Ohio.

* * *

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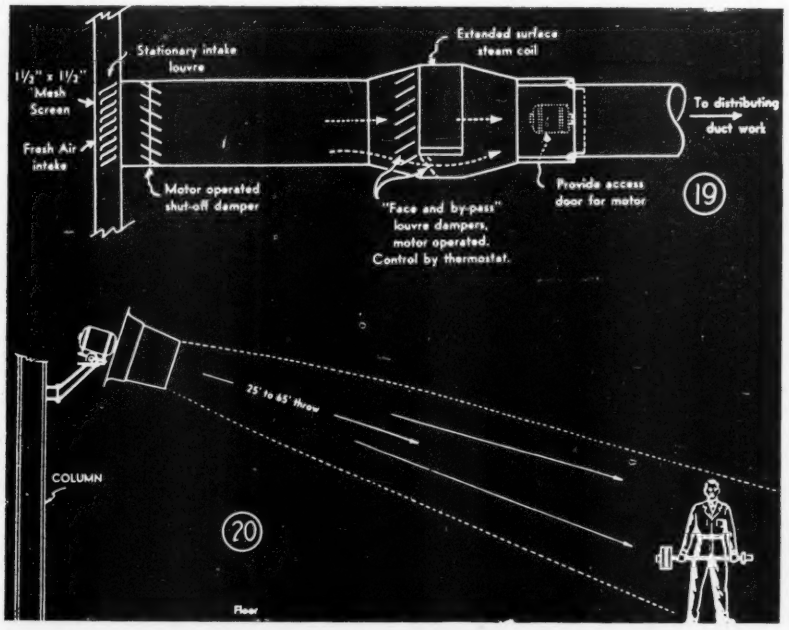

Fig. 19. — Axial flow fan for supplying fresh air to steel mill buildings. * * *

Fig. 20. — Man-cooler fan mounted on column blows cool air through intervening hot air. *

Wire Drawing Research in the British Iron and Steel Research Association

By W. C. Hessenberg
The British Iron and Steel Research Association
London, England

A short paper on wire drawing research with particular emphasis on the back-pull factor and its effect on dies. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

RESEARCH on the working of metals has always been active in Great Britain. Since the establishment of the **British Iron and Steel Research Association** in 1945 it has been given further encouragement. The work of this Association is divided into six divisions which cover all aspects of the manufacture of iron and steel. One of these divisions deals entirely with metal working problems, such as rolling, wire drawing, forging, etc.

* * *

THE Association's work on wire drawing was started about two years ago. A thorough survey of previous work in this field was made and a bibliography of wire drawing literature was prepared for the Association by the Iron and Steel Institute.[1] This contains more than 2,000 abstracted references to publications on wire and rod drawing dating from the end of the last century and classified according to whether they deal with theory, methods of manufacture, or properties and tests. The Carnegie Library of Pittsburgh very kindly allowed the Institute to make use of the Bibliography on Iron and Steel Wire compiled by **R. H. Phelps** in 1936. There is thus available to all interested in this branch of technology a valuable compendium of nearly all of importance that has been written on this subject.

* * *

SINCE then more detailed reviews of the theoretical aspects of wire and rod drawing have been made by **J. G. Wistreich,**[2] who is Head of the Wire Drawing Section of the British Iron and Steel Research Association's Mechanical Working Division, and **G. D. S. MacLellan**[3] working at Cambridge University on behalf of the Association.

* * *

THE theory of wire drawing has developed from attempts to calculate the drawing force and energy consumption in drawing from knowledge of the geometry of the die and the properties of the wire material. An exact solution of the problem, taking into account all the factors involved, would be extremely complicated, even if it were possible. For this reason all the theories at present known rest on a number of simplifying assumptions. One of the better known of the simple theories is that of **Sachs,**[4] which assumes, amongst other things, that the deformation in the die is homogeneous i.e. a normal plane cross section of the wire before drawing remains plain and normal to the axis of the wire after passage through the die. Experiments with split wires with grids engraved on the interface, and similar methods of observing the deformation of the wire, show quite clearly that this is not the case. Sachs also neglects the strain hardening of the wire, and assumes that the coefficient of friction is the same throughout the area of contact between the wire and the die. In spite of this his simple theory has proved valuable to an understanding of the process over a fair range of practical wire drawing conditions. It has been followed by more elaborate treatments of the problem, such as those of **Lunt** and **MacLellan,**[5] **Davis** and **Dokos,**[6] **Körber** and **Eichinger,**[7] and others.

* * *

PROBABLY the most exact analysis of the problem at present available is that recently put forward by **Hill** and **Tupper.**[8] This might be described as a by-product of a considerable advance in the fundamental theory of plastic deformation due to **Lee, Hill and Tupper.**[9] It is not possible to describe this new development within the scope of a paper such as this; it must suffice to say that previous theories of plastic deformation had assumed that a problem was solved if the stress distribution within the material being deformed was known. It is now shown that consideration must also be given to the distribution of strain for the exact solution to be obtained.

* * *

THIS theory as applied to wire drawing, accounts very well for a number of practical observations. For example, it is known from experience that for a given reduction there is a die angle for which the drawing force is a minimum, and there exist in the industry empirical methods of finding this. The theory shows how the higher drawing forces required for other angles depend, on the one hand, on the increased effect of friction in small angle dies, and on the other, upon increasingly inhomogeneous deformation when large angles are used. By inhomogeneous deformation is meant strains within the plastically deforming metal which

do not contribute to its final change of shape. The existence of this homogeneous deformation is well demonstrated by the experiments of **Linicus** and **Sachs**[10] who showed that wires had work hardened more after a given reduction through a die than after the same reduction given by stretching it in a tensile testing machine.

* * *

ALTHOUGH the theory of **Hill** and **Tupper** is probably the most exact yet available, it also involves simplifying assumptions. Finality has not yet been reached; the main obstacles to a further advance are increasing complexity of the treatment required and inadequate knowledge about the role of friction within the die, and the mechanism of plastic flow and work hardening in aggregates of metallic crystals.

* * *

PERHAPS the greatest interest in both the theoretical and practical sides of the programme has so far been shown in back pull or reactive wire drawing. The theoretical survey by Wistreich is concerned solely with this. It may be useful to restate the elements of the process here.

* * *

IN back-pull drawing tension is applied to the wire before it enters the die. The drawing force P, the die load, F, and the back-pull tension, Q, are related by the equation $P = F + Q$. In considering this relation one can imagine two extreme results of applying back pull; either the drawing force remains constant and the die load is reduced by Q, or the die load is unchanged and the back pull, Q, is added to the drawing force. It is found in practice that both the die load and the drawing force are affected in accordance with the following equations:—

$$P = P_0 + (1 - b)Q$$
$$F = F_0 - bQ$$

where Po, Fo are the values of P and F in the absence of back pull and b is a constant less than unity which Wistreich has termed the "back-pull factor".

* * *

THE back-pull factor is of considerable importance as it indicates the extent to which the die load is decreased as a result of applying back pull and it is from a decrease in die load that the potential advantages of back-pull drawing arise. The relation between the back-pull factor and the reduction in the pass has been the subject of much theoretical speculation. The actual relationship is affected mainly by friction and the shape of the die, but the general trend is that the greater the reduction, the greater the back-pull factor. It is therefore in the higher reductions that the potential effect of back pull in reducing die load with all its attendant advantages is greatest.

* * *

ABOUT a year ago the Association was given an opportunity of carrying out a programme of practical tests on a new back-pull wire drawing machine after it had been installed in the works of a member firm, but before it was put into production. The machine is a capstan type 4-hole machine designed and built by the **Marshall Richards Company.** Each block is independently driven and a total power of 160 H.P. is available. It is suitable for drawing mild steel wire from 1 S.W.G. and high carbon wire from 3 S.W.G., at speeds up to 1600 ft. per minute. It is equipped for the direct measurement of die loads. This investigation is now in its concluding stages and a final assessment of the value of back-pull drawing on the basis of these experiments is being made. The most important thing about the use of back pull is the fact that the load on the die is reduced. This means that the frictional forces between the wire and the die are diminished. One can therefore expect a reduction in die wear, a saving in power due to less work being done against friction, and for the same reason, less heating of the wire, an important matter when drawing high carbon steel. The question is whether any of these effects is large enough to be of commercial significance and it is hoped that the valuable experience gained with this machine will provide the answer.

* * *

THE wear of hard carbide dies is also being investigated. A survey has been made of hard carbide dies manufactured in Great Britain and has shown how varied are the compositions and qualities of hard carbide that are recommended by different manufacturers. Much work lies ahead in making careful comparisons between various types of hard carbide under different drawing conditions so that the variations in die performance, which are at present common experience, may be properly understood and eliminated.

* * *

OF particular interest are the methods of assessing the wear of dies. As is well known with hard carbide dies, the trouble is not only opening out of the die throat, but the development of a ring near the point of entry of the wire. The precise reasons for the formation of this ring are not yet fully understood. Considerable thought has been given to the photography of the internal surface of dies, particularly with a view to detecting the first traces of ringing. Figures 1 - 8 show photos of a die taken after various lengths of mild steel wire had been drawn through it. The initiation and gradual intensification of the ring can be observed. Figure 9 shows another die photographed in cross section showing the ring, and Figure 10 is a photomicrograph of the region of the ring showing the removal of the cobalt binder and the tendency of the carbide particles to crack and fall out.

* * *

THE profile of the worn die can also be measured to within a 10,000th of an inch by a new profilometer under development in the Association's Physics Laboratories. In this instrument a delicate probe is passed through the die and its movement measured optically. It is also valuable for determining the exact profile of the die after grinding, especially the vital part at either side of the throat. Figure 11 shows the general design of the instrument.

* * *

A more rough and ready method of doing this has been described by **Wistreich**[11]. A cast is

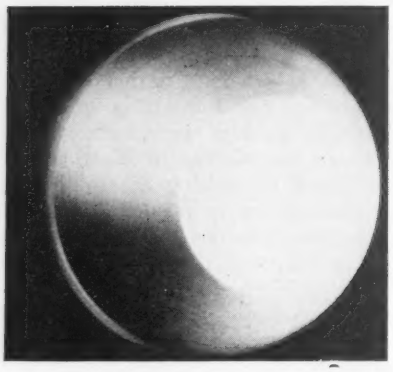

Fig. 1. — Unused Die.

.1825″ diam. 12° drawing angle. No parallel. Second die in 4 hole drawing of .65%C patented 3 SWG rod. Incoming wire to this die was .213″ diam. Lubricant — dry soap.

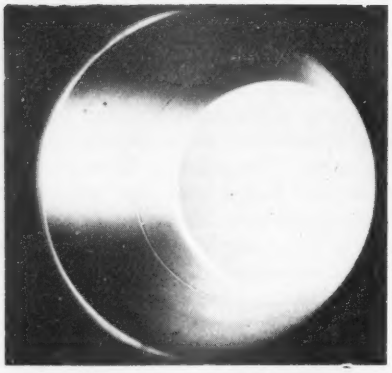

Fig. 2. — After drawing:

12 coils
=3168 lbs.
=11900 yds.

(See Fig. 1 for details)

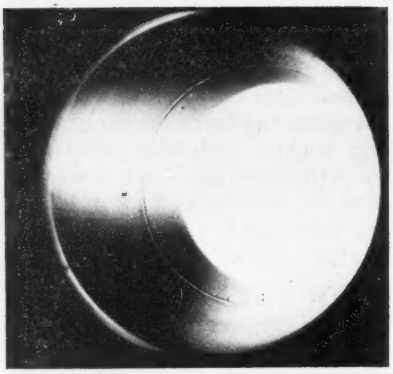

Fig. 3. — After drawing:

24 coils
=6312 lbs.
=23700 yds.

(See Fig. 1 for details)

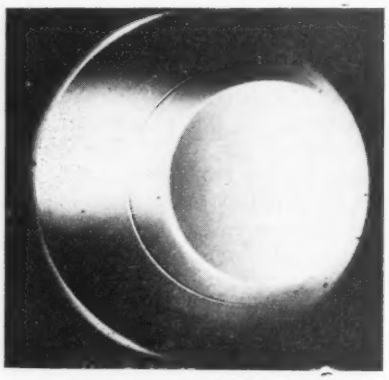

Fig. 4. — After drawing:

36 coils
=9256 lbs.
=34600 yds.

(See Fig. 1 for details)

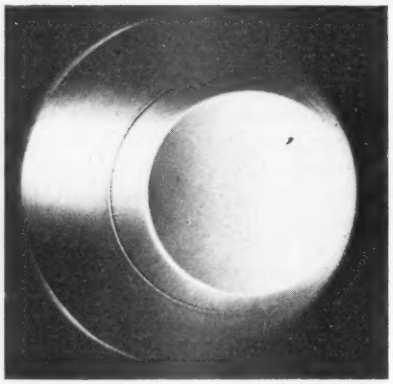

Fig. 5. — After drawing:

48 coils
=12300 lbs.
=46000 yds.

(See Fig. 1 for details)

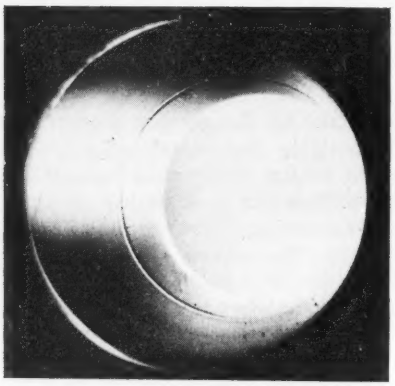

Fig. 6. — After drawing:

60 coils
=15388 lbs.
=57500 yds.

(See Fig. 1 for details)

made of the interior of the die with a dental compound which immediately after setting is of a rubbery consistency. This enables the reentrant portion of the cast to be withdrawn through the die throat so that the portion just beyond the throat is included in the measurement of the profile. This is an improvement on the old **Wood's Metal** technique where care had to be taken to stop the casting at the throat or else it could not be withdrawn without damage.

* * *

THE Association is sponsoring work at Manchester University on the effects of temperature on wire draw-

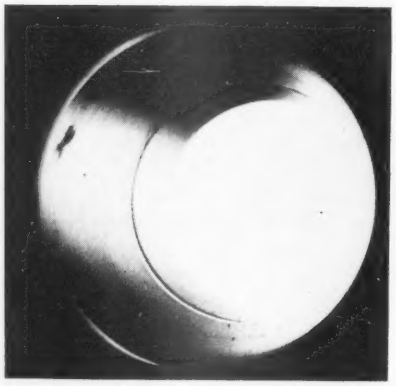

Fig. 7. — After drawing:

72 coils
=18516 lbs.
=69200 yds.

(See Fig. 1 for details)

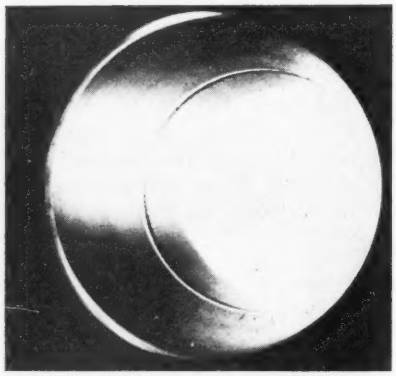

Fig. 8. — After drawing:

84 coils
=21665 lbs.
=80900 yds.

(See Fig. 1 for details)

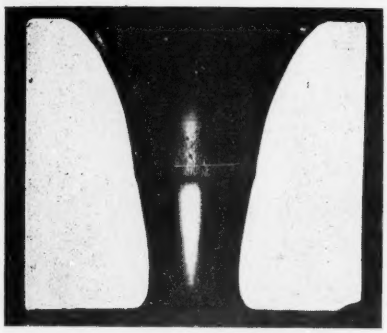

Fig. 9. — Heavily Ringed. Sectioned Die Pellet. Throat diam. .160". Magnification, approx. X5.

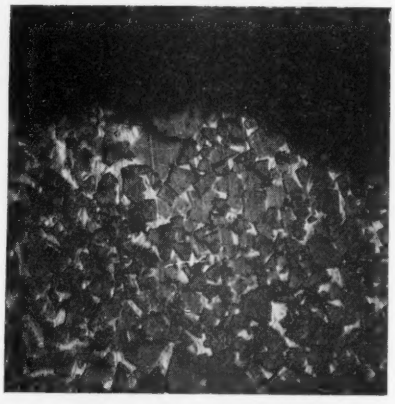

Fig. 10. — Microphotograph showing die surface in vicinity of ring. Magnification X1500 (etched with alkaline potassium ferricyanide). * * * *

ing. The work is being carried out under the direction of **Prof. F. C. Thompson**, and is at present confined to studies of high temperature drawing. Obviously, the interaction between metallurgical and mechanical effects during deformation at high temperature is extremely complicated, but over-riding this in importance is the question of lubrication. The development of a suitable lubricant for drawing at high temperature has therefore been given first priority and some interesting progress has already been made in this direction.

THE foregoing account of the Association's wire drawing investigations is necessarily somewhat fragmentary. The programme is rapidly developing from quite recent and relatively modest beginnings. Present conditions in Great Britain are such that progress in building up such a research programme is hampered by shortage of staff and suitable accommodation, and much effort is going into overcoming these obstacles that will later be free to be devoted to intensification of the programme itself. In the meantime,

(*Please turn to page* 980)

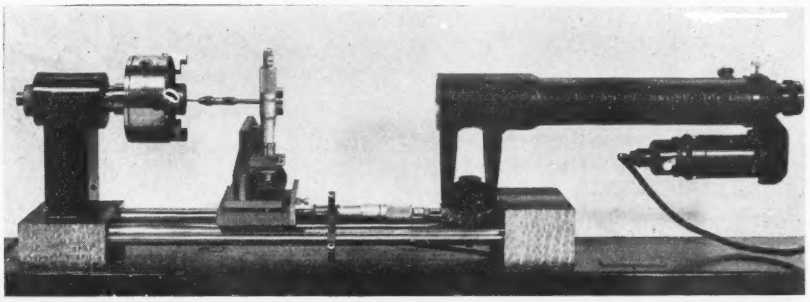

Fig. 11. — Die Profilometer. * * * * *

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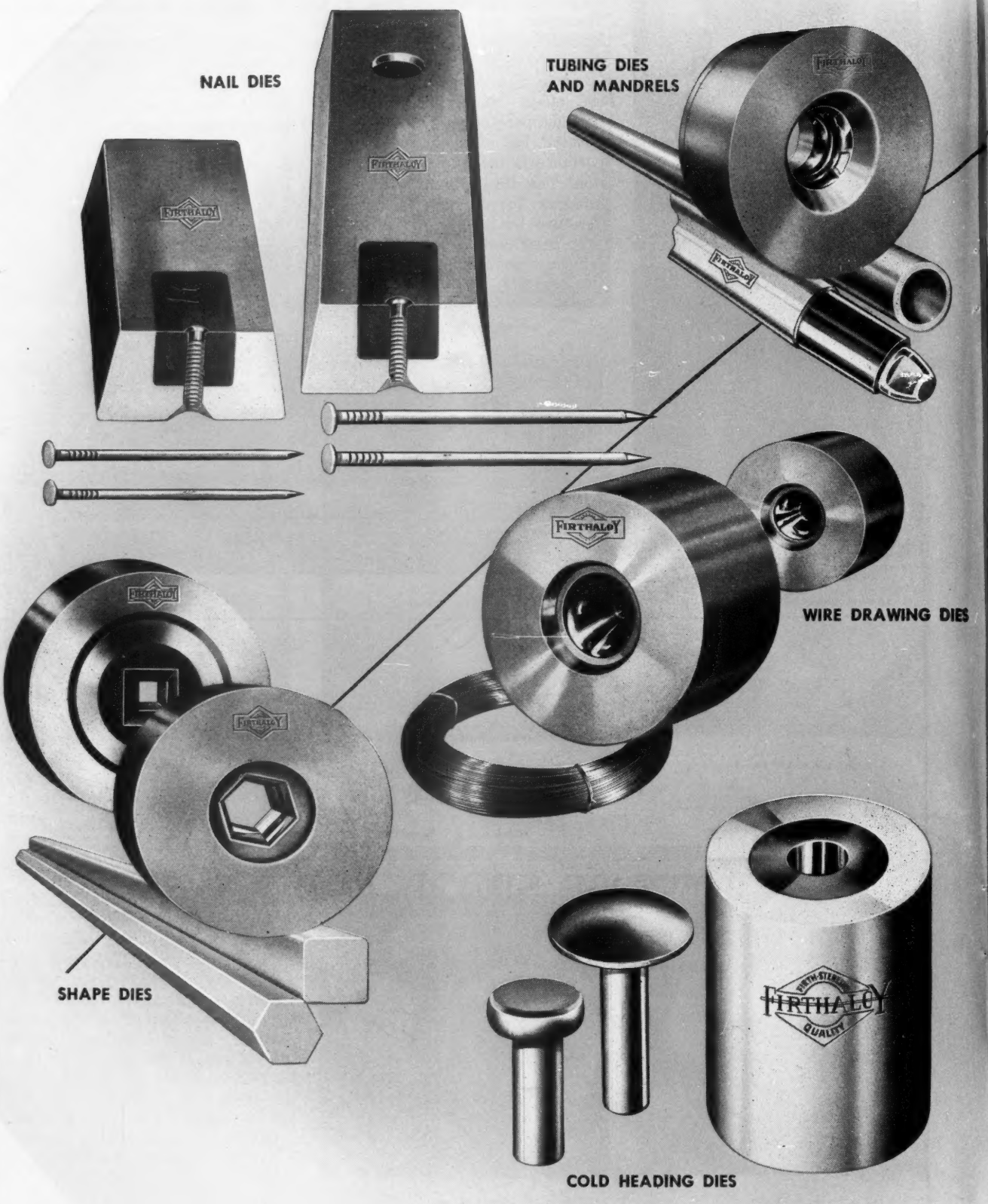
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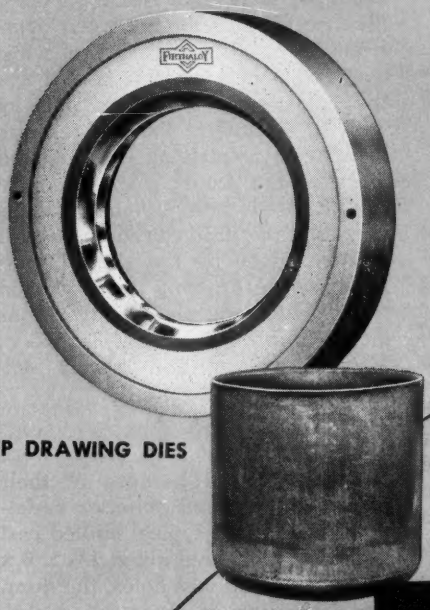

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Practical Application and Mill Practice with Carbide Dies

By E. T. Miller, Die Service Engineer

Firth Sterling Steel & Carbide Corp.,
McKeesport, Pa.

Contrasts of previous die practices with modern methods of wire drawing using carbide dies. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

THE making of wire is an ancient art. The Assyrians and Babylonians used wire in 1700 BC. The Bible mentions quote: "Beat gold into thin plates and cut it into **wires"** unquote. These were flat wires inasmuch as they were undoubtedly hammered. The use of the die block method of drawing round wire dates from early in the eighth century and commercial wire drawing in France began in the thirteenth century.

* * *

THE first wrought iron and copper alloy wires drawn in the United States came from Norwich, Conn. in 1775. The appearance of steel wire had to await the Bessemer and Open Hearth Steel Making Methods around 1858. In 1860 **Lauth** patented a cold rolling process for the cold sizing of large hot rolled wrought iron bars, permitting subsequent cold drawing into wire. This last invention set the stage for the phase of rapid growth in the wire drawing industry. A survey of literature on wire drawing indicates that this important subject has not been reported extensively in print. Other than one text of English origin, the subject has been largely described only in trade papers.

* * *

THE original drawing implements took the form of steel die or Wortle plates. Figure 1. presents the appearance of a typical multiple hole plate. Rods and wires to and including 16 SWG were drawn through plates 1½ x 5 x 12, while smaller wires were drawn through six hole plates. The large number of holes was necessary because they quickly wear oversize, often averaging no more than 150 pounds of wire or about ½ bundle per hole.

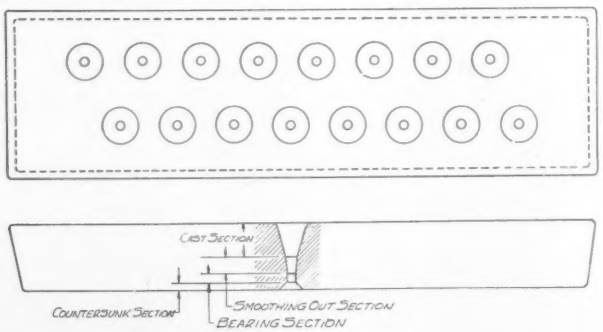
* * *

THE holes for drawing the product were punched hot and sized with hardened and tempered tapered punches. The material commonly used was cast Crucible steel containing at least 1.6% carbon which was mainly in the form of cementite with just sufficient pearlite to permit closing the holes by cold peening when it became necessary to reset or resize the holes because of their having worn oversize. After the holes were worn oversize, the plates were heated and the holes were closed by peening with a hammer. Then the holes were reset by driving in a tapered pin until the proper shape and hole size desired was obtained. This operation required considerable skill and was done by the wire drawer making wire drawing a highly paid trade. Later, die plate compositions included more than 2½% carbon, 14% chromium and nearly 4% Tungsten.

* * *

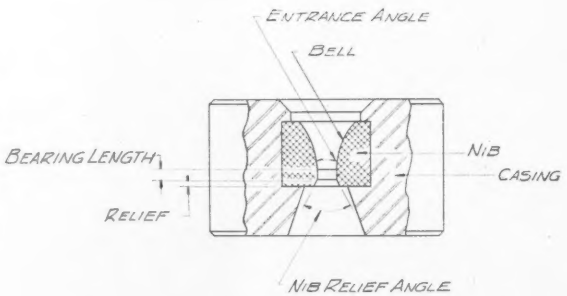
CHILLED cast iron plates were widely used because of their great hardness and superior resistance to wear. A typical chilled cast iron plate measured **about 1¼ x 6 x 12** with tapered cast holes, the number depending on the starting size, some with only three holes weighed up to 40 pounds and were used for drawing ½" and larger size rods. Others had three staggering rows of six holes each and weighed less than 12 pounds.

* * *



CAST IRON (STEEL) DIE PLATE

FIGURE I. * * * * *



CONVENTIONAL CARBIDE DRAWING DIE

FIGURE II. * * * * *

DIE rooms were established and the dies were made by Die Reamers. They made and ground their own tools, which also required remarkable skill and generally required two to three years before a man was considered good enough to make finish size dies.

* * *

MAKING Cast Iron Dies consisted of first countersinking a back relief using the drill press, then opening the drawing angle with what was called a smoother. This also was done on the drill press. The smoother was ground by hand and although they did not use a protractor to check the angles, by the checking of old smoothers kept as souvenirs, the angles were found to be 18° to 22° included. The thick plates permitted recutting to relatively large hole sizes.

* * *

THIS resumé of previous practice is presented for contrast with modern methods of wire drawing, using carbide. Carbide dies probably made their appearance in this country in 1928 and so rapid was their adoption that since 1932 they have been used extensively, replacing steel and cast iron die plates almost completely. Their use has resulted in almost a three fold increase in drawing speeds up to more than 1500 feet per minute on ferrous metals and considerably higher on non-ferrous metals, additional advantages being greater accuracy, longer life, improved finish on the product and more economical use, because carbide dies are much easier to recut and maintain. Figure 2 shows a conventional carbide drawing die with a sintered carbide nib supported in a steel casing. It is also apparent that the transition from steel and cast iron plates to carbide design was accompanied by refinements in the interior contour or the working area of the die. Notice particularly the well shaped bell to provide adequate lubrication, the entrance angle to blend the bell into the reduction angle which is of proper size for the material being drawn, the straight bearing for accurately sizing and finishing of the wire and the relief angle to provide proper clearance to eliminate drag on the wire after sizing as well as marking the wire particularly when shutting down and starting multiple drawing machines.

* * *

FIGURE 3 details the various parts of a wire drawing nib and shows the nature of the reduction effected by the passage of wire through the die. Note particularly the working zone within which the entering material first touches the drawing surface at the draft line. As indicated, a reduction or draft is often expressed as the difference in area of the product and that of the entering wire in per cent. Present drafting practice involves up to 38% reduction on low carbon and from 25 to 30% for high carbon or spring wire. The drawing, or reduction angle ranges from 14° to 18° for low carbon wires and is reduced to about 12° for high carbon or rope wire.

* * *

SINCE their introduction some twenty years ago, the design and size range of carbide die nibs has changed but little. Table 1

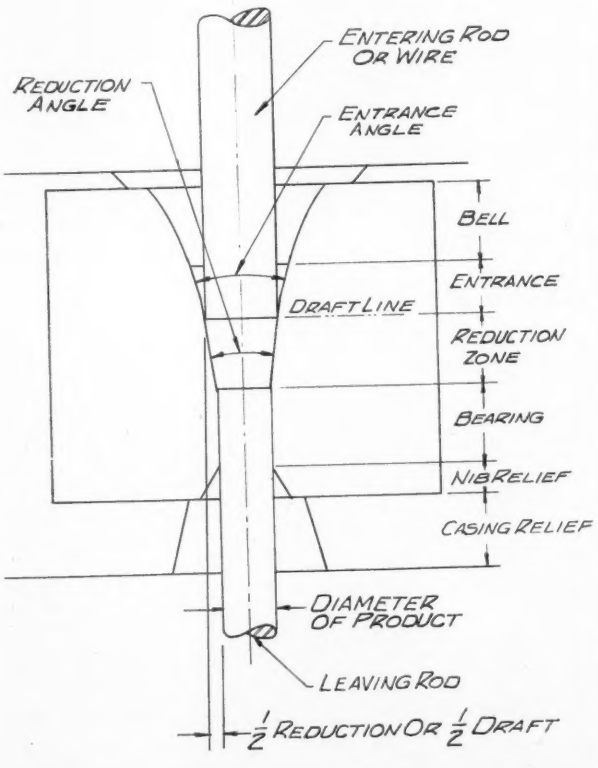
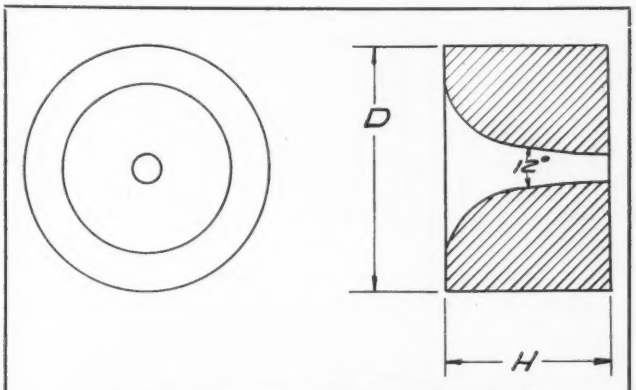


FIGURE III. — WORKING ZONE OF DRAWING DIE * *



NIB DESIGNATION	NIB SIZE D	H
R-1	0.325	0.200
R-2	0.325	0.300
R-3	0.450	0.350
R-4	0.500	0.400
R-5	0.625	0.575
R-6	0.710	0.670

TABLE I. — CURRENTLY STANDARD NIB SIZES * * * *

presents current nib sizes which are virtually standard with all suppliers. These sizes were predicated on a purchase price basis and manufacturing limitations, rather than from a consideration of wire mill needs. Figure 4 clearly shows that the height of a carbide nib imposes a much greater limitation upon the size of wire which can be drawn than nib diameter. Obviously the higher nibs permit a wider and higher bell opening as well as a longer working zone to admit larger entering wire without increasing the size of the reduction angle to the point where excessive die pull would be developed.

* * *

WE believe that a new approach should be made to the question of carbide die design from the user's viewpoint. Many users purchase rough cored dies at or near the minimum hole size. These dies are finished in the users die room to the smallest possible size for drawing fine wire. When the original hole wears oversize, the dies are successively recut to the largest possible hole for breakdown use. From this it is evident that the usefulness of a die is determined by the maximum hole size to which it can be recut, or in other words the largest entering rod or wire size it can accommodate.

* * *

OUR observations as well as the experience of many users clearly indicate that the currently standard nib heights listed in table 1, are too short. Figure 4 shows that at the maximum recommended hole size there is an excessive unused nib wall. Recutting beyond the maximum recommended hole size in an endeavor to utilize the carbide wall thickness which must be otherwise scrapped, is impractical. With a short nib the entrance and reduction angles become too wide in trying to make room for a larger entering size, and the draw pull and back pressure become too great. This may result in excessive power consumption, and the possibility of impairing the finish of the drawn wire, due to the formation of slivers from overcrowding in the reduction zone, resulting in nib or wire breakage. As a further consequence of too short a nib notice that the bell becomes too shallow for proper lubrication and guiding of the wire into the die.

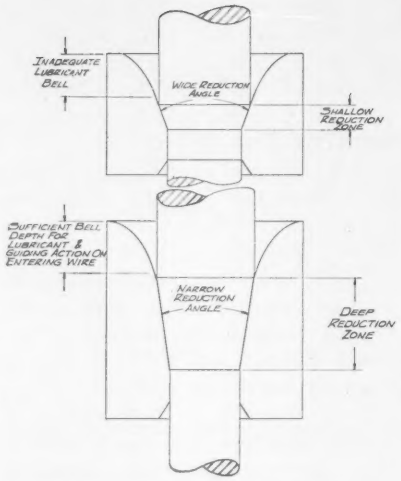

INADEQUATE LUBRICANT BELL
WIDE REDUCTION ANGLE
SHALLOW REDUCTION ZONE
SUFFICIENT BELL DEPTH FOR LUBRICANT & GUIDING ACTION ON ENTERING WIRE
NARROW REDUCTION ANGLE
DEEP REDUCTION ZONE

FIGURE IV. — Short Versus High Nibs. *

* * *

IN Part A of figure 5, we see that the finishing and reworking of the old style nib meant cutting and enlarging a back relief in the hard metal nib, which was not only time consuming but rapidly destroyed laps. In Part B it is clear that **merely adding a cored relief in the back of the nib would not materially improve the situation,** because the inclusion of this relief naturally moves the bearing up and seriously limits the remaining nib height, which must include the reduction and entrance angles and the bell.

* * *

OUR new nibs shown in Part C are higher by at least the amount of the cored relief. The increased nib height provides, 1. A deeper and wider bell for the lubricant, which in turn minimizes the reworking necessary to preserve a smooth entrance contour as shown in Figure 6. The longer bell and entrance angle also will tend to properly align entering wire coming from a guide or a preceding pass at an angle. The new high nibs afford room for the most efficient drawing angle in the reduction zone, and the new nib height permits a cored back relief based on the maximum recommended hole size. This means that there is no neces-

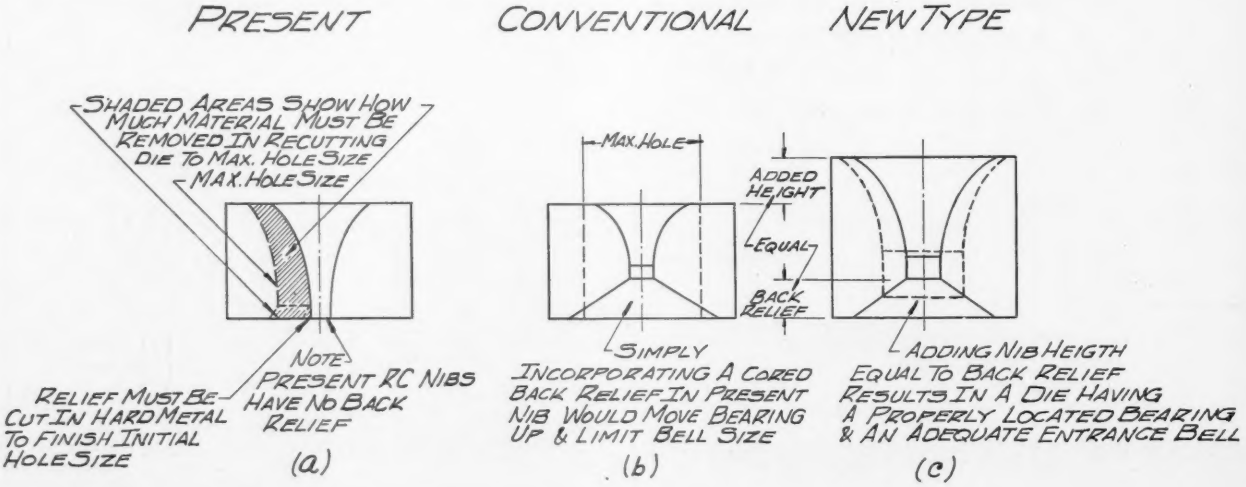

PRESENT
CONVENTIONAL
NEW TYPE
SHADED AREAS SHOW HOW MUCH MATERIAL MUST BE REMOVED IN RECUTTING DIE TO MAX. HOLE SIZE
MAX. HOLE SIZE
NOTE PRESENT RC NIBS HAVE NO BACK RELIEF
RELIEF MUST BE CUT IN HARD METAL TO FINISH INITIAL HOLE SIZE
(a)
MAX. HOLE
ADDED HEIGHT
EQUAL
BACK RELIEF
SIMPLY INCORPORATING A CORED BACK RELIEF IN PRESENT NIB WOULD MOVE BEARING UP & LIMIT BELL SIZE
(b)
ADDING NIB HEIGTH EQUAL TO BACK RELIEF RESULTS IN A DIE HAVING A PROPERLY LOCATED BEARING & AN ADEQUATE ENTRANCE BELL
(c)

FIGURE V. — ROUGH CORED NIBS: * * * * *

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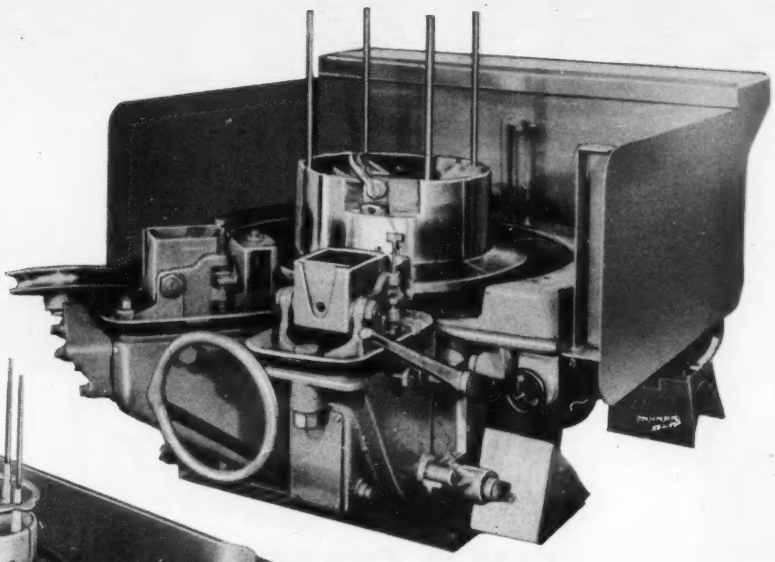

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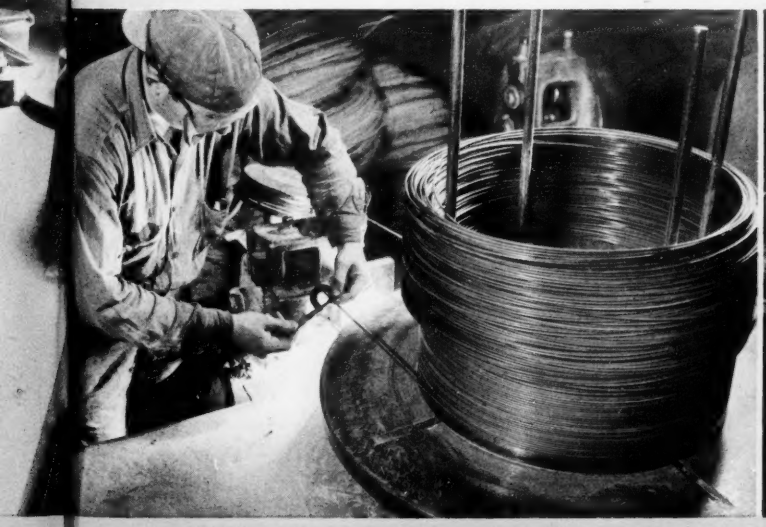
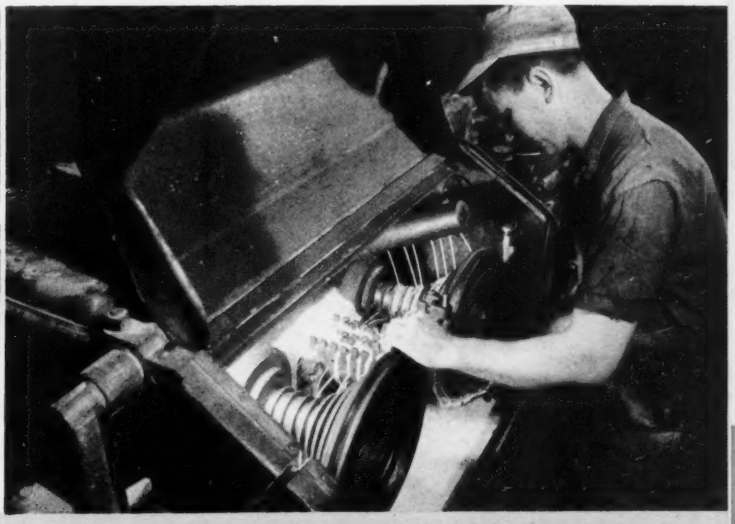


Vaughn Motobloc, double-deck type.



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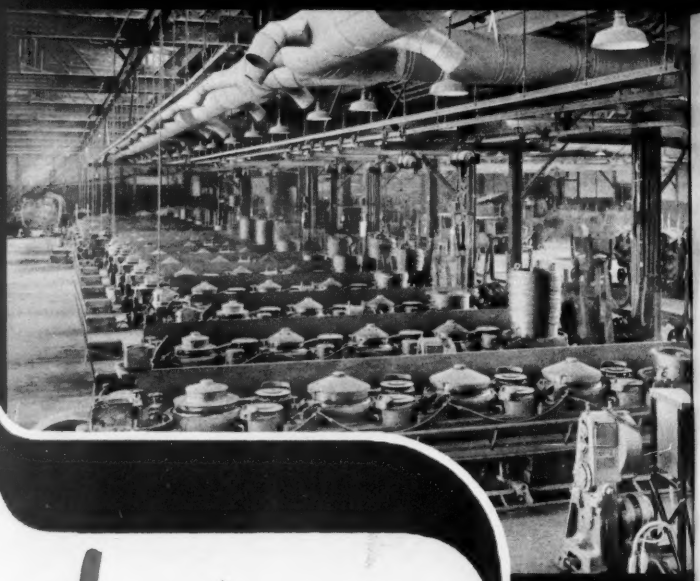

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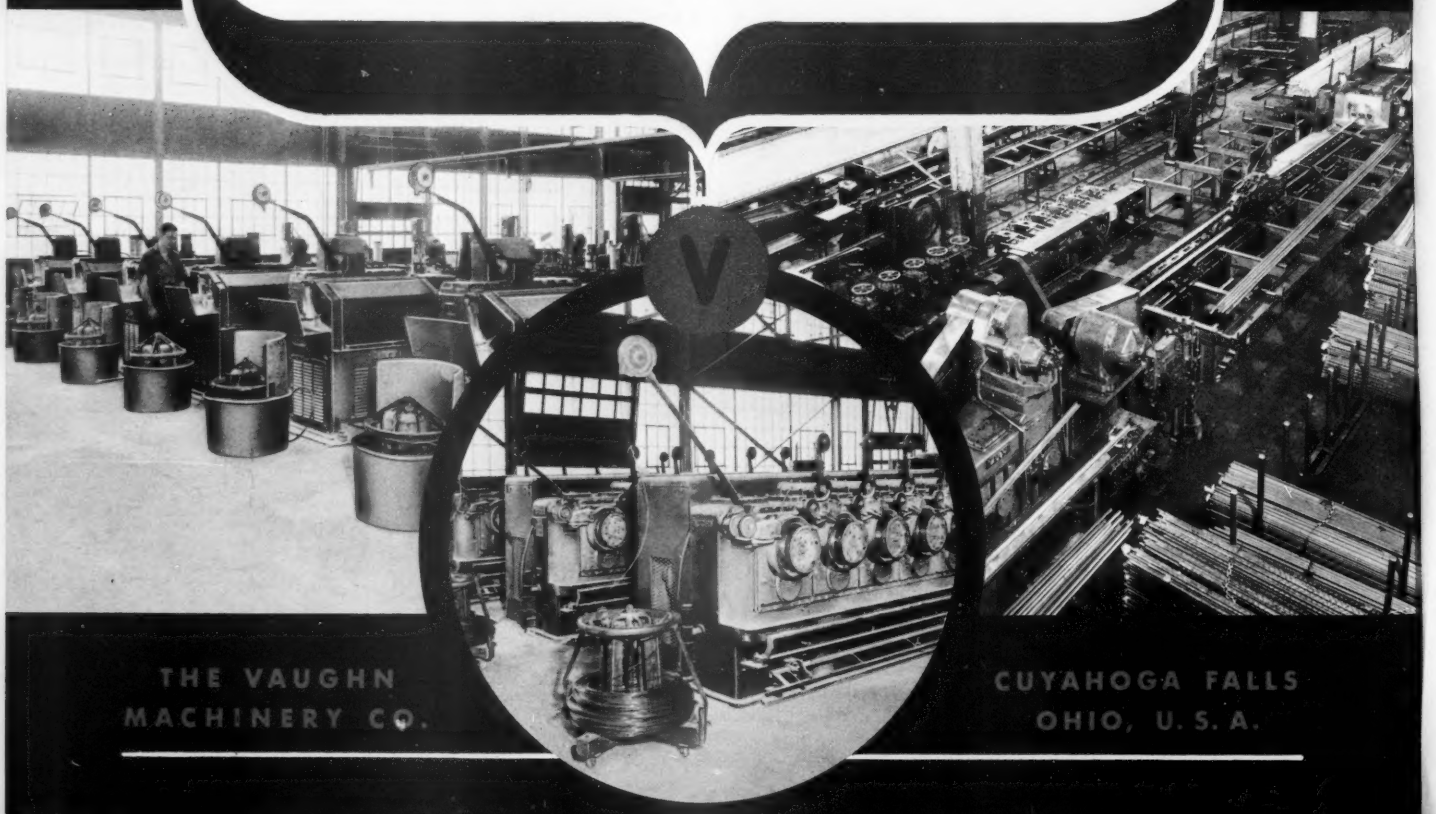

THE VAUGHN MACHINERY CO.

CUYAHOGA FALLS OHIO, U. S. A.

sity to touch the relief as the die is recut successively to the maximum hole size. This feature alone will save many hours in the user's die room.

* * *

IN addition to using a rough cored nib of the proper design and size, best results require that the proper interior shape be maintained. Each time the die is recut to a larger size, we recommend the reduction angle be first recut to accommodate the next larger wire size to be drawn. Then the bearing can be enlarged from the back of the die to the corresponding size of drawn wire.

* * *

FIGURE 7 shows in solid lines the contour of a rough cored die with a small hole. If the die is recut as indicated in dotted lines, it is clear that only the small shaded portion need be removed to blend the reduction angle with the bell.

* * *

THE new higher nibs with cored back relief have been thoroughly tested under the most exacting conditions, including the drawing of copper, carbon steel and stainless steels.

* * *

IN summarizing we wish to emphasize that this is not only an improved die but a basically new and balanced design incorporating the recommendations and suggestions of both users and machine suppliers. This makes it possible for the user to purchase dies of nib size more closely suited to his requirements for drawing rods to finish wire size. The resulting reduction in die inventory should make this die equally attractive to both the purchasing department as well as drawing and die maintenance divisions.

* * *

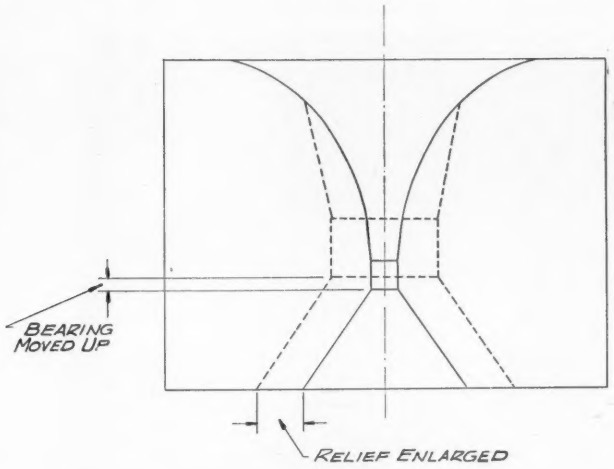

FIGURE VI. — RESULT OF ENLARGING RELIEF. * * *
———RCN with small hole
- - - - - - NIB recut to larger hole by enlarging bearing and relief from back — Pushing drawing angle and bell too far forward to front of NIB.

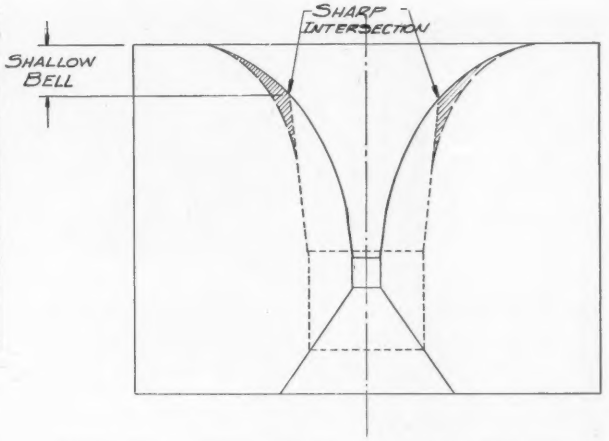

FIGURE VII. — SUGGESTED BELL CONTOUR AFTER ENLARGING HOLE. * * * * * *
———RCN with smalle hole
- - - - - - NIB recut to larger hole
—·— Recommend bell countour
/ / / / Material which should be removed after recutting bearing and reduction angles.

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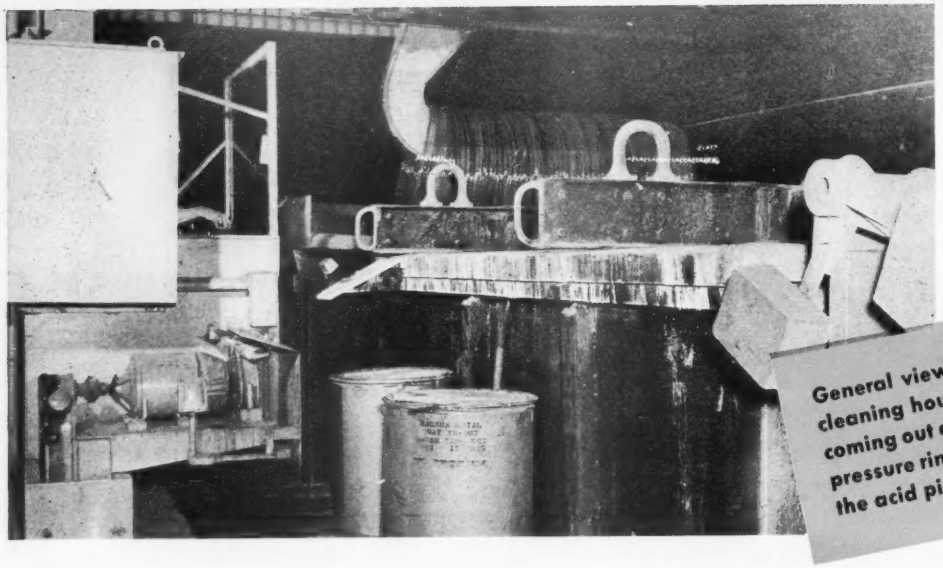
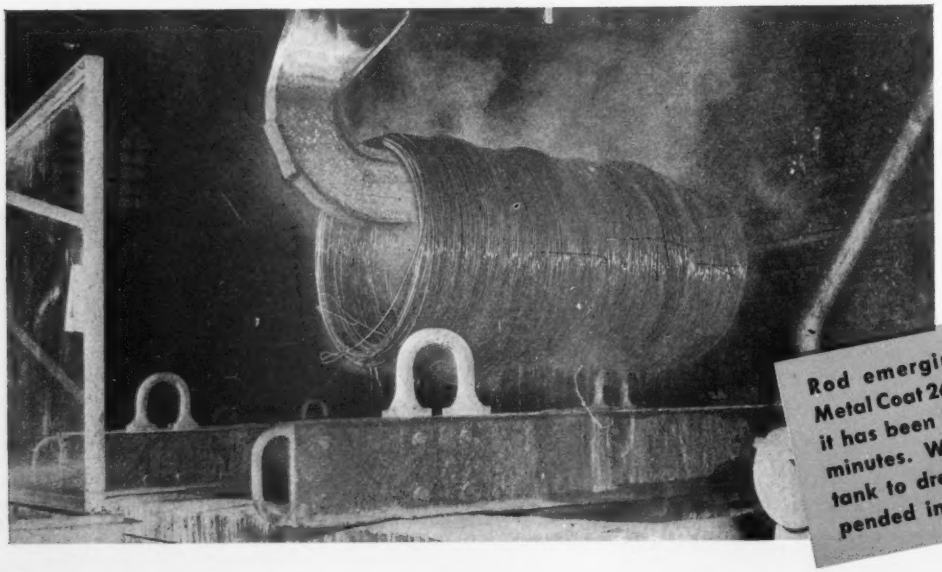


General view of new modern cleaning house, showing wire coming out of cold water high-pressure rinse. Also shown are the acid pickling tanks.

From Dipping to Drawing—With Magnus #267...

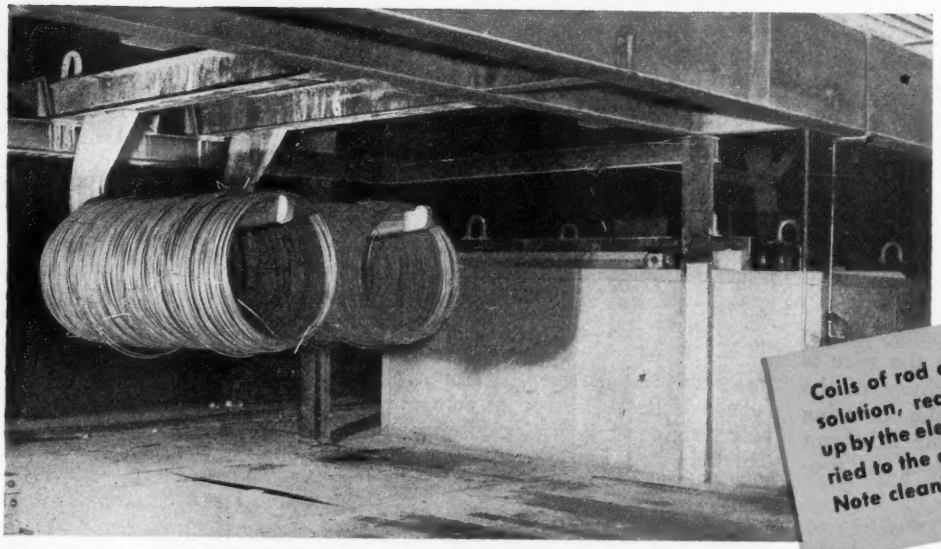


Rod emerging from the hot Metal Coat 267 solution in which it has been immersed for three minutes. Wire is hung above tank to drain and is then suspended in dryer for 1 minute.

Magnus CLEANERS · EQUIPMENT · METHODS

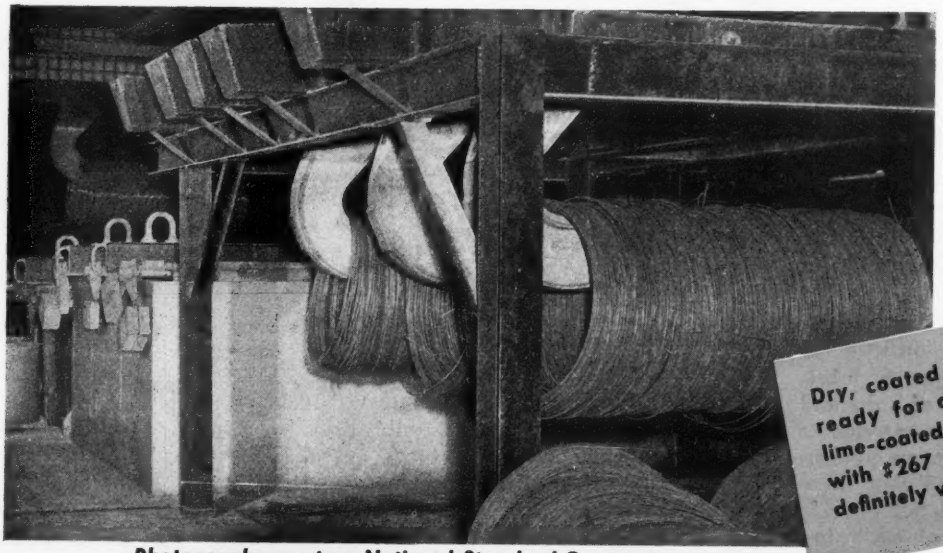
AND BAKING METAL COAT #267...

Speedier Drawing... Cleaner Finishes



Coils of rod coated with #267 solution, ready to be picked up by the electric truck and carried to the drawing machines. Note cleanliness of floor.

15-20 Minutes. With Liming...4-6 Hours.



Dry, coated wire on racks, ready for drawing. Unlike lime-coated wire, wire coated with #267 can be stored indefinitely without rusting.

Photographs courtesy National-Standard Company

MAGNUS CHEMICAL COMPANY • 188 South Avenue, Garwood, N. J.

IN CANADA — MAGNUS CHEMICALS, LTD., 4040 RUE MASSON, MONTREAL 36, QUE.

A Method for Measuring the Effect of Die Shape and the Use of Various Lubricants in Non-Ferrous Wire Drawing

By Carl B. Shopmyer

Chemical Section — Works Laboratory
General Electric Co.
Schenectady, New York

Describing a new method of measuring the effect of die shape and lubricants in non-ferrous wire drawing. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

DURING the last decade the demand for small-diameter insulated magnet wire has increased tremendously. Instrument manufacturers, especially those engaged in the production of aircraft equipment, require and insist upon wire of the highest quality.

* * *

IMPORTANT factors which influence the ultimate quality of the finished wire are the quality of the copper rod from which the wire is drawn, mechanical condition of the drawing equipment, the drawing dies themselves, and the lubricant which is used to facilitate the process.

* * *

THE content and quality of the copper rod may be tested chemically and physically in the laboratory; if it is approved here, it becomes the responsibility of the wire mill to draw the rod into a high-quality wire.

* * *

ALTHOUGH the mechanical condition of the drawing equipment is very important, maintenance is strictly a mill problem. In the Schenectady Works wire mill, an increasing number of problems have been found to arise from the drawing dies and the lubricants in use.

* * *

WHILE it is not difficult to chemically analyze a lubricant or to make a cast of a die and obtain its important measurements by projecting this cast on a comparator, it was realized that these analytical methods did not provide for the measurement of other important factors involved in the wire-drawing process. It was concluded that dies and lubricants should be tested under conditions which duplicate, as nearly as possible, the actual drawing operations.

* * *

THE design of an instrument to yield this desired information required the assistance of someone with engineering background and experience in the instrument field. Fortunately, the Scott Tester Company, of Providence, Rhode Island, expressed a desire to develop such an instrument. This company built a pilot-model die-pull tester which was delivered for trial. Since this instrument is merely a pilot model and by no means represents the final design, it will not be discussed in detail at this time.

* * *

IT is well to discuss next some of the interesting questions about dies and lubricants in which there is opportunity for much research. First to be considered is the drawing lubricant, of which the following are three essential requirements:

1. **It must lubricate the wire and dies to minimize power requirements.**
2. **It must cool the dies to the optimum operating temperature.**
3. **It must be "free rinsing".**

* * *

THE three types of lubricant most used today are vegetable oil, synthetic oil, and animal fat, or stearate-base lubricant. Animal fat lubricant is probably the most popular in the United States. The fat-to-soap ratio can be controlled and is usually varied from a high soap and low fat content for fine wire to high fat and low soap content for coarse wire or rod. Most wire mill engineers, at some time in their careers, have recommended replacement of the lubricant being used with another which, due to its chemistry, appeared to be better. Such a substitution has often been followed by the development of familiar difficulties like sticky draw blocks, plugged dies, excessive foaming, formation of copper soaps, or wire breakage. These difficulties cannot be immediately blamed on the new lubricant; the mill probably mixed the new material in exactly the same manner as the old, mixed it to the vendor's recommendations, or is using a suggested mixture which worked satisfactorily in some other wire mill.

* * *

ALTHOUGH the work which has been done to date with the die-pull tester is strictly preliminary, it has been greatly encouraging. It is hoped that authorative answers will be found to such controversial questions as the effect of copper soap in a solution, the optimum pH range, and the effect of water when used with various lubricants.

* * *

FIGURE I illustrates an example of one type of research work which has been done and which, it is planned, will continue. Actual pounds of pull required to draw copper wire from AWG size 33 to 34 were plotted against concentrations in pounds per gallon of water for three chemically different lubricants.

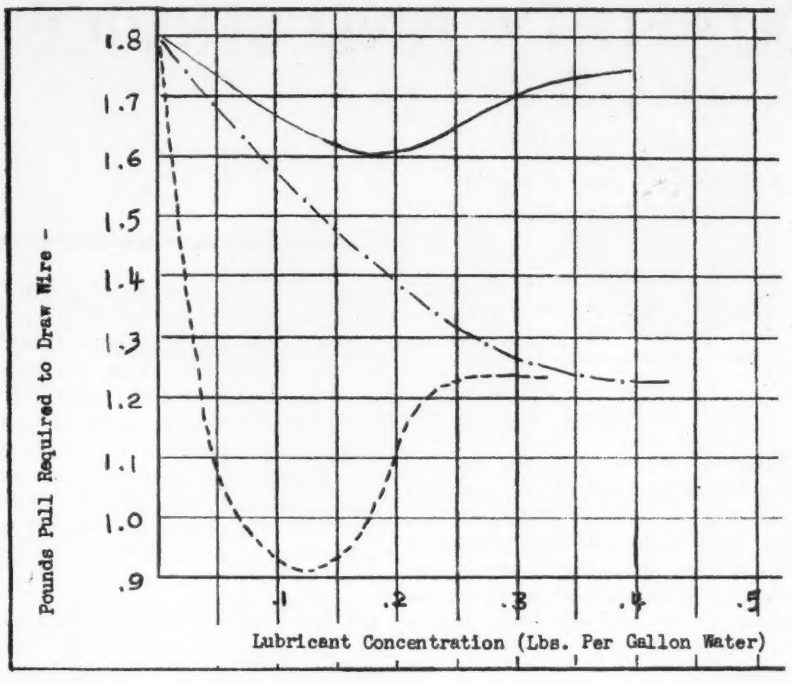


Fig. 1

Temp. 120 — 125 F.
Speed 250 feet per min.
Size #33 to #34

——— Lubricant "A"
—.— Lubricant "B"
- - - - - Lubricant "C"

IT was observed that lubricant "A" requires a minimum pull when mixed at the rate of approximately 0.2 pound per gallon of soft water. As the mixture becomes more concentrated, the pull required increases until a solution of 0.4 pound per gallon of water is reached.

* * *

THE data for lubricant "B" produced an entirely different curve. The optimum mixture, in this case, is approximately 0.4 pound of lubricant per gallon of water. This material is unique in that power consumption curve does not ascend as the mixture becomes more concentrated.

* * *

WHEN using lubricant "C", pull decreases very rapidly and concentration is considerably less when the minimum pull figure is reached. It is also interesting to note that the pull curve rises rather rapidly as the concentration is elevated above the optimum po'nt.

* * *

FROM thees curves it may be concluded that lubricant "C" is the most efficient providing the concentration is controlled between very close limits. It is also safe to assume that power and material are wasted and unnecessary die wear is resulting if the solution is allowed to reach a concentration of 0.2 pound of lubricant per gallon of water. Of course, other factors must be considered before a final conclusion can be reached.

* * *

THE die-pull tester has yielded equally interesting results when used to test wire-drawing dies. Factors which have been found to influence the pull required to draw wire through diamond dies are approach angle, bearing length, relief, and polish.

* * *

IT is a generally accepted fact that die shape is much more difficult to control in diamond dies than in tungsten carbide dies. However, preliminary work has indicated that with the cooperation of the die manufacturers this will be an excellent opportunity to increase die life and improve wire quality. Tests indicate that if the included approach angle is increased from 16 to 25 degrees and the same bearing length is maintained, power requirements increase approximately 25 percent. Changes in bearing length have a similar effect; for the high speed machines now in service a short bearing length is desirable.

* * *

IT is logical to assume that the combination of approach angle and bearing length is very important. Repeated observations have been made of the fact that dies with approach angles in the vicinity of 25 degrees and bearing lengths in excess of 50 percent of hole diameter will, at high speeds, draw undersize wire. These dies usually require resizing much sooner than those with smaller approach angles and shorter bearings.

* * *

IN conclusion, it is hoped that when a new die-pull tester, which is still in the developmental stage, is completed, it will be possible to maintain better control in the factory and also to indicate to the die and lubricant suppliers the exact requirements of our mill. With their cooperation, such control should mean the maintenance of high quality wire production at lowered costs.

TO WIRE MILL MEN

The Wire Association is for the specific purpose of improving production methods. It has been organized as a clearing house of ideas on technical problems and research work in all phases of practical wire drawing and wire working.

The inquiries discussed were received from and answered by members of the Wire Association. These inquiries are sent to the Secretary of the Association who acts as a central clearing point, and neither the names of the firms, nor individuals sending the inquiry, nor of the men or firms replying are divulged without permission.

QUALITY, QUANTITY AND SERVICE

By Norman T. Nelson, Jr., Ind. Engr.

Rod & Wire Mills

Bethlehem Steel Company

Sparrows Point, Maryland

An investigation of scheduling practices in a fully integrated Rod and Wire Mill, prepared for presentation to the 1948 convention of "The Wire Association."

Introduction

THE present market for rods, wire, and wire products is composed of several thousand major consumers who buy a hundred odd kinds of products, composed of several hundred grades of metal, and who put those products to many thousand end uses. Trading in a competitive market of this kind calls for mass production of quality products timed to meet the customers' need.

* * *

TIMING is the essence of scheduling. Timing calls for the coordination of the sales and production facilities to bring home to the customer enough of just what he wants when he wants it. This kind of coordination is the object of all scheduling practices.

PART I

Some Fundamental Considerations Governing the Selection of a System for Coordination of Sales and Manufacturing Facilities

1. A rod and wire mill is not a merchant mill. To be sure, there are some merchant products made such as barbed wire, common nails, even-weight bundles of annealed wire, and some even-weight bundles of galvanized wire. But for the most part a rod and wire mill is a "Custom-Built" or made-to-order proposition. Most customers will specify sizes to very odd decimals, or specify a grade of steel which defines the chemical composition to narrow but practical limits, or both, and very often finish, coil weight, tensile strength, etc., are subject to exacting definition. Even with respect to the few merchant products that are made, there is reason in this case to treat the entire mill as a made-to-order manufacturer. Therefore, manufacturing facilities must be locked in step with sales, and conversely sales must consist of the products and amounts of which the manufacturing facilities are capable.

* * *

2. UNCOATED steel wire is perishable. Rusting of uncoated steel wire is even now the subject of much investigation throughout the industry. While many answers to this problem have been found, and we look forward to the results of current research, the fact remains that some of the products are perishable. Therefore, the methods selected for coordinating the customer's use, the salesman's order, and the mill's production must be geared to minimize the time between production and end use.

Preface

THIS discussion is the result of study and development at the *Sparrows Point plant of Bethlehem Steel Company*. This plant contains a fully integrated Rod & Wire Mill which is one of the largest of its type in the country for the production of coarse, round, carbon steel rods, wire, and wire products.

* * *

ALTHOUGH the nature of operations in alloy, non-ferrous, shape, and fine wire mills is technically different from those under study, it is felt that the basic similarity of hot rolling rods and cold drawing wire presents similar scheduling problems to most all large integrated mills.

3. IN the case at hand we are dealing with a fully integrated mill. There is no dependency on outside sources of billets, since the steel making facilities can supply the full range of kind, amount, and size of billets required. There is no dependency on outside sources of rod supply since the rod mills can roll any diameter required by the drawing facilities now existing.

* * *

IN this example, the rod mill can most economically roll each size from its smallest to its largest at least once every 28 days. Some of the more popular sizes are rolled more often, but at least any order can be rolled, drawn, and finished within a calendar month. For this reason, in combination with others which will be later apparent, the mill schedules are issued on a monthly basis. An adaption of the calendar month in the case of wire and wire products is the base period most practical for scheduling purposes in this example.

PART II

A Scheduling System Based On Mathematics for Coordinating Sales and Manufacturing

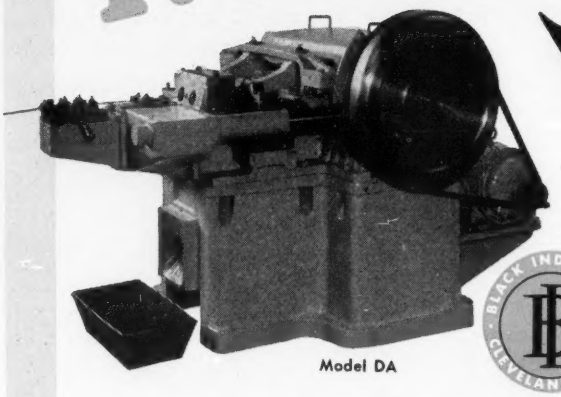
The Loading Control Boards (Figure 1)

THE mathematical methods used for adjusting sales and operations to lock sales in step with production are called loading controls.

* * *

PROPER mathematical loading control is the seat of the coordination between sales and operations. The methods used for dividing the orders by products, and assigning the tons of work required will be treated later. The essential fact is that with adequate system for ob-

NEW WIRE NAIL MACHINE



Model DA

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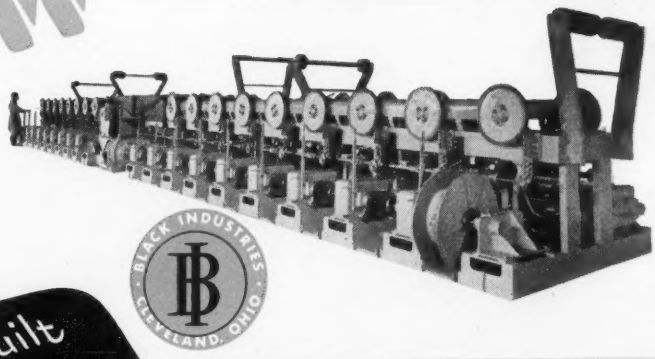
NEW 36 REEL WIRE TAKE-UP FRAME

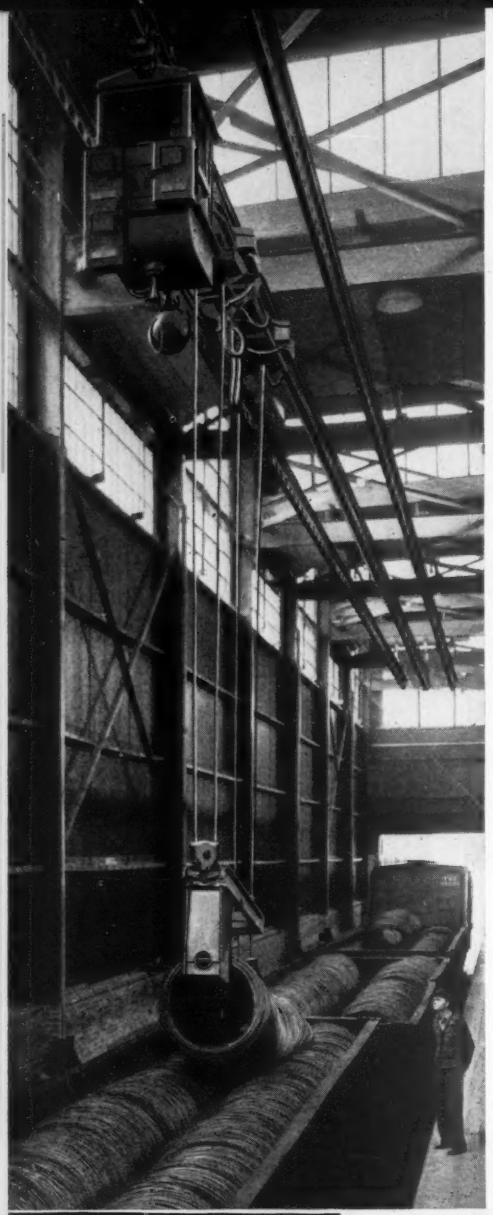


- CONSTANT TENSION
- NO-SLIP CLUTCHES
- NO RIDERS ON WIRE
- SIMPLIFIED CONTROLS
- ALL A. C. DRIVE

Designed and built by BLACK

Used in processing line for plating steel wire. This principle can be adapted to other processing or product lines for taking up strip or wire products. BI engineers will modify the design to suit the requirement for single units or multiple-reel or block-type frames.

Literature on request



Every Year—

MORE ROD PRODUCERS SWING TO CLEVELAND TRAMRAIL

The list of Cleveland Tramrail users in the Wire & Wire Products Industry is growing larger every year because the many installations serving this important field have proven convincingly that great savings can be made by handling the materials overhead.

The Cleveland Tramrail hairpin-hook system has greatly lowered shipping and rod storage costs. Up to eleven 300 lb. bundles of rod can be picked up, transported and discharged by the Tramrail cab operator alone.

Approximately 40% of the basic rod production of this country is stored via Cleveland Tramrail. Another 10% is handled in the plants of manufacturers who purchase rod.

The hard work of block stripping has been greatly lightened with easily propelled cranes and carriers provided with fast, snappy hoists and rigid-arm push-button control.

More than 50 installations of Cleveland Tramrail single-leg gantry cranes have been made in straight-line cleaning houses. These cranes handle from 50 to 450 tons in 24 hours. Floor space is saved — sometimes up to 80%.

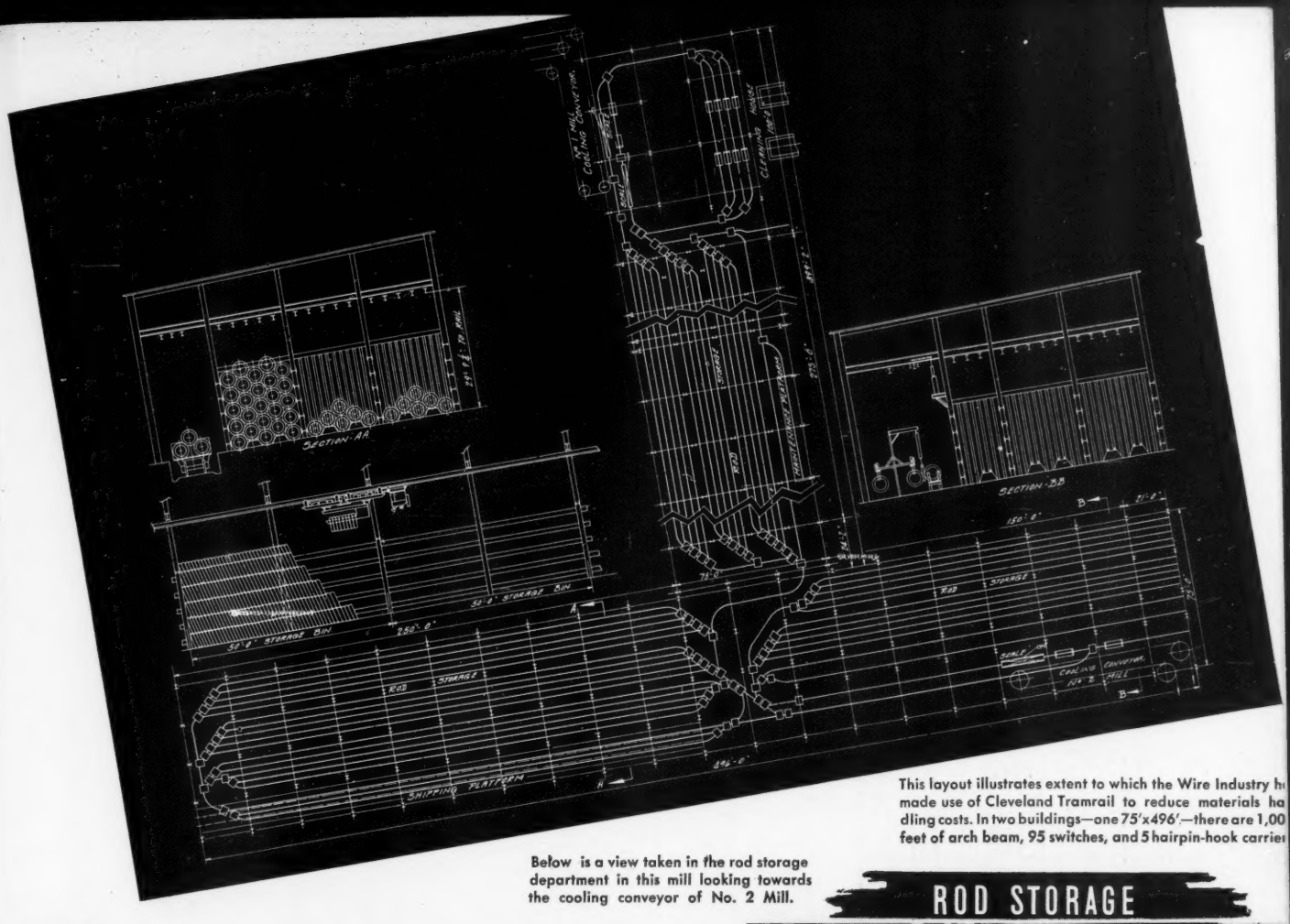
Cleveland Tramrail equipment is available for all branches of the wire industry.

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
9211 EAST 288TH ST. WICKLIFFE, OHIO

CLEVELAND

SHIPPING

BLOCK STRIPPING

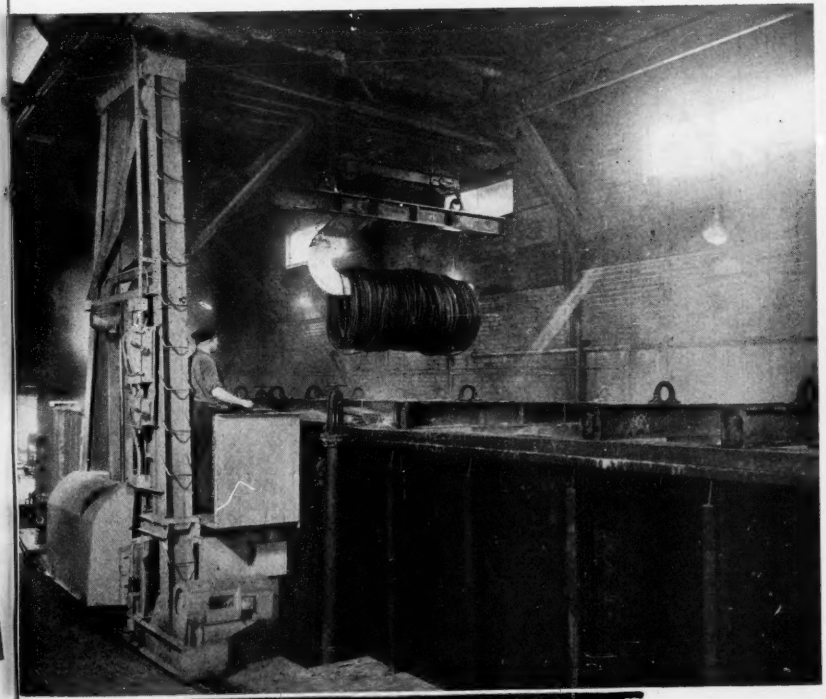


This layout illustrates extent to which the Wire Industry h made use of Cleveland Tramrail to reduce materials ha dling costs. In two buildings—one 75'x496'—there are 1,00 feet of arch beam, 95 switches, and 5 hairpin-hook carrie

Below is a view taken in the rod storage department in this mill looking towards the cooling conveyor of No. 2 Mill.

TRAMRAIL

ROD STORAGE



CLEANING HOUSE

Fig. 1.—MONTHLY LOADING CONTROL BOARD

BETHLEHEM STEEL COMPANY SPARROWS POINT PLANT ROD & WIRE MILLS LOADING CONTROL COMPUTATIONS

Data as of 7:00 AM _____ For the period _____ to _____

PRODUCT	Net tons of Product	OPERATIONAL WORK																						Product Turn Rate	Turns Requ'd	Turns Ava'bl	Overload or Underload	
		#1 Mill Rods	#2 Mill Rods	#2 Mill Bars	Drawn Size 625/235	Drawn Size 234/148	Drawn Size 147/065	Drawn Size 064/032	A/A Patent	A/L Patent	L/L Patent	Pot Anneal	Beths. Soft Zinc	Beths. Hard Zinc	Beths. Fine Zinc	Beths. T-1 Zinc	St.Out #1 Mach.	St.Out #2 Mach.	St.Out Other	Galvan. Frame Feet							Turns	Tons
raight Bars																												
briated Bars																												
raight Cut Bars																												
thanise Soft																												
thanise Hard																												
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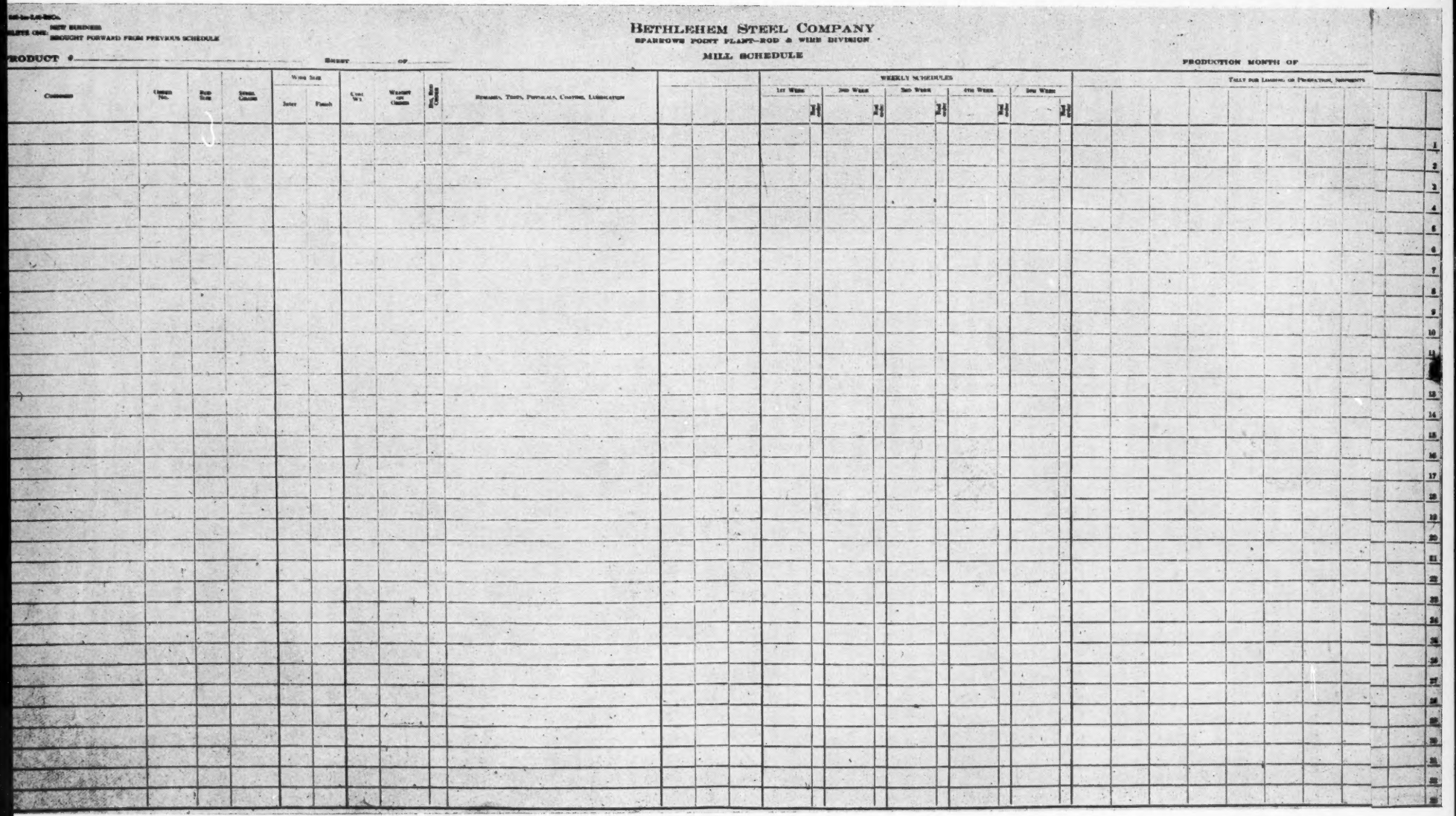
Fig. 2. MONTHLY MILL PRODUCTS SCHEDULE



NEW BUSINESS
SHEETS ONE: BROUGHT FORWARD FROM PREVIOUS SCHEDULE

BETHLEHEM STEEL COMPANY
SPARROWS POINT PLANT—ROD & WIRE DIVISION
MILL SCHEDULE

PRODUCT # _____ SHEET ____ OF ____ PRODUCTION MONTH OF

| Customer | Customer No. | Rod Size | Steel Grade | Wire Size: Inter | Wire Size: Finish | Coat Wt. | Weight per Coil | Bar Code | Remarks, Tests, Furnaces, Coating, Lubrication | | | | WEEKLY SCHEDULES: 1st Week | 2nd Week | 3rd Week | 4th Week | 5th Week | Tally for Loading or Production, Shipments | | | |

taining accurate figures, those figures will demonstrate just what adjustments need be immediately made to lock sales and operations in step for the coming schedule period. These adjustments are loading control points. They cannot be overlooked. Like a ship at sea, if it is overloaded on one side it will capsize toward that side, and conversely if it is underloaded on one side it will capsize toward the opposite side.

* * *

AT the present time several loading control boards are used: One for the Nail Mills, one for the Wire Mills, and one for the Rod and Bar Mills.

* * *

THE product load is the sum (in net tons) of the sold orders to be produced within a given schedule period.

* * *

THE operation load used is the tons of work, or feet or work, or pounds of plating work presented to the various operating departments by each product load.

* * *

THE loading control period should be 1 and ½ base schedule periods, and therefore the product loads will be the sum (in net tons) of the balance to produce on the current schedule plus the new orders for the next period.

* * *

THERE must be adequate diversity by products. Orders for processed wire must be in proportion to orders for annealed wire or else the annealing pots will be flooded during the period, or conversely the finishing blocks will be flooded and the pots will be idle part of the time. Orders for strand and cable must be in proportion to orders for plated wire or else the plating cells will be flooded during the period, or conversely the stranding department will be flooded and the plating cells idle part of the time. Orders for hot rolled rod must be in proportion to the orders for bars, wire and wire products, or else the rod mills will be flooded, or conversely the wire mills will be flooded and the rod mills idle part of the time. And so on.

IN addition to adeuqate diversity by products, there must be adequate diversity by operations. For instance, given the correct proportion of low carbon bright wire product, if the diversity by sizes is incorrect, one set of drawing blocks will be flooded while another set is partially idle.

* * *

THE loading control boards will demonstrate kind and amount of underload or overload for a given period. The loading control adjustments consist of deferring orders to the next schedule period in the case of overloads, or else advancing orders of a kind to fill the holes where underloads exist. Of course, in the case of underloads, operations can be curtailed, but this is not always possible or practical. Curtailments usually mean laying off men which is not only hard on the men affected, but leaves the mill with the necessity of costly hiring and training of green men when that type of operation is again required.

* * *

OMISSION or neglect in alleviation of overloads results in inability to combine carloads of various products for shipment to the same destination, and also results in inability to fill orders for a complete range of sizes of one product. Omission or neglect in alleviation of underloads results in piling up the warehouses with material for which there is no immediate sale.

* * *

LOADING control is the actual demonstration, based on mathematics, of the very necessary coordination between sales and operations for the purpose of giving your customers quality products in quantity on time. The actual mechanism for doing this requires some other explanations first.

The Mill Product Schedule (Figure 2)

WE talked before about "products." What is a product? A product is material ready for shipment which has passed thru a particular sequence of operations in manufacture. Thus, hot rolled rods for shipment is a product regardless of size — its sequence: billets to rods to cars and out. And, patented rods for shipment is a different product regardless of size — its sequence: billets to rods to patenting to cars and out. Also, low carbon wire in coils regardless of size is a different product from upholstery spring wire in coils by virtue of the patenting operation involved in process. And then, low carbon wire in coils is a different product from low carbon wire in straightened and cut lengths by virtue of the straightening and cutting operation in process.

* * *

FOR each product there is a monthly mill product schedule. This schedule is a list of the details of all the customer orders for that product which have been sold for that month. Now there are several important things to realize at this point:

First, the salesman on the road is selling according to quota figures based on the experience of the previous month's loading control adjustments.

Second, the schedule maker has not yet made up the new loading control board. He is merely listing in order to be able later at a prearranged date to cut off the receipt of orders and start adding his product and operational loads for the new control computations.

Third, the schedule maker must have all metallurgical and processing information on each item of each order before he can assign the orders to their respective product schedules.

* * *

THE mill product schedule as issued contains all the metallurgical and processing information on each item, and are cross referenced in the cases of combination products on the same order. There are columns on the schedule for the product provider to lay out the schedule by weeks, and other columns for use in tallying the product and operational work load, furthermore, columns for use in tallying the actual production and shipments of each item.

The Mill Product Provider

THE product schedules are divided between a number of product providers. Each product provider is charged with the responsibility for causing material to flow to his

product on a weekly and daily basis from the next previous operation. He tallys the production and shipments of his product. He may incidentally be required to cause material to flow through his operation for use in filling orders of the provider in the next finishing department down the line, however his main responsibility is for his own shipping products. Note that in the case of nearly all the operations part of the material produced is ready for shipment at that point and the balance of the material produced will pass down the line for further processing and shipment by the next product provider on the line.

* * *

AT a prearranged cutoff point near the first of every calendar month the product provider will relist all the unshipped and unmade balances on his product schedule. As the mill passes into each new schedule period the product provider will have a total product schedule consisting of the relisted balances from the previous schedule period plus the schedules for the new orders entered for the new period. We will go over the mechanism of laying out the weekly and daily product requirements in more detail shortly.

The Mechanism for Obtaining The Loading Control Figures

EACH product schedule feeds figures into a loading control board in the following manner, take for example Barbed Wire:

* * *

AT a prearranged point in the middle of each schedule period, the product provider takes off a total of the unmade balances to produce (if any) on the Barbed Wire product schedule relisted from the previous month plus the unmade balances to produce on the Barbed Wire product schedule for the current month. He states his load as — tons of product load which will require — feet of galvanizing operation work load which will require — tons of wire drawing size range work load which in turn will require — tons of rod mill size range work load. He passes this information to the loading control supervisor.

* * *

IN turn the supervisor takes similar load figures from the Barbed Wire product schedule for the next schedule period, and places both sets of figures in the columns provided on the loading control board.

* * *

THE supervisor knows the number of tons per turn produced by the Barbed Wire machines, and also the number of turns those machines will operate in 1 and ½ schedule periods. A simple division will determine whether that product is underloaded or overloaded. If there is an overload he will mark a deferment against certain orders on the new schedule to alleviate the overload. If there is an underload he will obtain additional orders to fill the gap or as a last resort recommend a curtailment of operations in the event orders cannot be obtained.

* * *

THIS same procedure is followed in figuring the balance to produce on the Galvanized product schedule by that provider. In turn the loading control supervisor knowing the number of feet per turn produced on the Galvanize frame, and the number of turns the frame will operate in 1 and ½ schedule periods, can balance the operational load on the frame presented by the adjusted barbed wire schedule plus the operational load presented by the Galvanized product against the frame capacity. He will arrive at a loading control figure and make his deferments or advancements to bring the schedule in phase with the operation. The control adjustments cause corresponding adjustments to the work load in the wire drawing size ranges.

* * *

THIS mechanism of adding, dividing, and adjusting the product orders proceeds from the last finishing unit down the line all the way up to the Rod Mills. This is carried out on a routine basis once each schedule period with the following results:

First, the product schedules adjusted and issued are within the capacity of the mill to produce, therefore all the carload combinations of sizes and products can theoretically be made within the period.

Second, the Sales Department is immediately aware of the trend of the trade and can adjust the quotas for their men on the road.

Third, the operating department is immediately aware of the requirements of the trade and can make adjustments within limits to the machinery to meet the demand.

Fourth, a mathematical basis for estimating shipping dates has been provided for the benefit of overseas shipments and domestic customer inquiry.

PART III

Methods Available for Carrying Out On a Weekly and Daily Basis The Overall Planned Operations For the Monthly Schedule Period

IN the foregoing discussion there has been a very brief description of the methods used to carry out the operation as planned. The main reason for this is the desire for clarity; however, there is a more subtle reason for the brevity. Although the weekly and daily operations must be based on and intimately associated with the mill product schedules, the selection of a system for planning the operations for a schedule month does not of itself ordain a particular method for carrying on the weekly and daily operations. All of the work in planning is for the one purpose of making it at least theoretically possible to do a portion of the work each day in each department and come out at the end of a schedule period having produced exactly what the schedule called for, no more, no less. The possible schemes for weekly and daily scheduling are many.

* * *

A wire and rod requirement system is now in operation in the typical mill we have discussed so far in conjunction with properly loaded mill product schedules.

Weekly Memorandums and Steel Orders: (Figure 3)

HAVING mathematically loaded the mill to begin with, the loading control supervisor can tell before the schedule period begins at what rate in tons per turn by products and size ranges the material must be rolled, drawn, and finished. Bear in mind that each

product provider is stationed at and is responsible for the operation from which his products for shipment will be taken off. Then, knowing the turn rate required for finishing each product by size ranges or kinds, and further knowing the turn rate at which his finishing mill operates, he can lay out for himself in the columns provided on the product schedule just what amounts of each order he must finish during the coming week.

* * *

AT this point it is well to mention that three other things have already taken place. First, the Rod Provider has laid out the sequence of size changes on the rod mill in accordance with rod mill loading control board and distributed same for information of all Product providers. Second, certain customers who have large steady requirements have outlined just how they will need their material by weeks. Third, at a meeting or meetings with the other providers he has ascertained what part of his operation will be consumed by processing material for other products than his own.

* * *

THEN with the predetermining factors in view, as we mentioned before, the Product provider can lay out his weekly schedule about five days in advance in the columns provided on the product schedule. He makes a memorandum of this which is duplicated for use of the shipping department and the Billet provider. A feature of this memorandum is that it takes very little time to make out once the weekly plan has been made, and by posting the memorandum on copies of the appropriate product schedule, the shipper and the Billet provider can immediately determine the exact details of just what is needed and what is coming. Moreover, the loading control supervisor receiving a copy of the memorandum can check at a glance the progress of the product schedule by weeks. In addition to this, the Billet provider is able to recapitulate the requirements for all products in order to arrive at the proportions of his orders to the open hearth for the coming week.

IT is well to mention here that the exact definition of a schedule period hinges on the use of the weekly memorandum. Since each provider has in his hands at any given time only the relisted balances and new business for the current schedule period, all properly loaded, the schedule period must consist of an even number of weeks. Otherwise, the product provider would be labored with working from two sets of schedules at the beginning and end of each calendar month. In practice, it is easy enough to divide the calendar year into 12 months. It is then further divided into 4 quarters, each quarter consisting of two 4-week periods and one 5-week period. This retains the facility of naming each schedule period for the month which it most nearly approximates, and keeps the sales and scheduling records more nearly in agreement with generally accepted accounting procedures.

Daily Wire Stock Requirements and The Daily Mill Lineup by Machines: (Figure 4)

WE have gone over the processes for properly loading the entire mill for the entire schedule period. Further, we outlined how that load can be laid out by weeks just in advance of each week's beginning, bearing in mind the whole scheme of loading as well as proper phasing of the customer's requirements, rollings, and shipping dates requested.

BETHLEHEM STEEL COMPANY
ROD & WIRE MILLS SCHEDULING DIVISION
WEEKLY MEMORANDUM

Delete One: New Business
Carried Forward from Previous Schedule.

Tuesday.....19.....

PRODUCT #.....: .....Sheet.....of..... Production Month of.....

Following are the quantities to be scheduled during the.....week beginning 7:00 A.M. Monday.....

Please enter this list on your copy in the weekly column provided and make arrangements to produce and ship accordingly.

LINE	CUSTOMER	QUANTITY	LINE	CUSTOMER	QUANTITY
1			18		
2			19		
3			20		
4			21		
5			22		
6			23		
7			24		
8			25		
9			26		
10			27		
11			28		
12			29		
13			30		
14			31		
15			32		
16			33		
17			X		

Routing:

Fig. 3. MEMORANDUM OF WEEKLY MILL PRODUCTS SCHEDULE

THE last problem is to carry out on a daily basis the operations dictated by the weekly memorandums. In the typical mill under study, this is being accomplished by the 40-hour wire requirement in combination with the corollary 40-hour machine lineup for each department. This procedure is the responsibility of the Product provider stationed at each finishing unit working under supervision of the operating General Foreman of the respective units.

* * *

THE procedure is the same in all finishing units each day and proceeds in this manner; the product provider stationed at the given finishing unit posts production from the previous day on his product schedule in the columns provided, takes an actual count of the material on trucks ready for processing, and surveys with the foreman the condition of the equipment. Then, following the weekly schedule which he laid out for his products plus the weekly requirements for which he allowed for other products, knowing his wire count, knowing the balance due him from his previous wire requirement, he lays out his requirements of wire for the next 40 hours. He then proceeds to the central scheduling office where by appointed turn, he confirms with the wire drawing provider that what he needs can be had. Adjustments are made on the spot, and following this he returns to his own unit to make up a 40-hour machine lineup based on the orders for which he has just secured wire.

* * *

THE wire drawing provider in the central office is charged with the responsibility of combining the 40-hour requirements from all the units and placing them on the various machines by issuing daily the 40-hour wire drawing block lineup. He is responsible for the redrawing material requirements, for the scheduling of reclamation work, for the supervision of the inventories of material in process, and for the running rate tally by size ranges.

(*Please turn to page* 995)

D 635-10m-3,47-BSCo.

BETHLEHEM STEEL COMPANY

SPARROWS POINT—ROD & WIRE DIVISION

WIRE STOCK REQUIREMENT

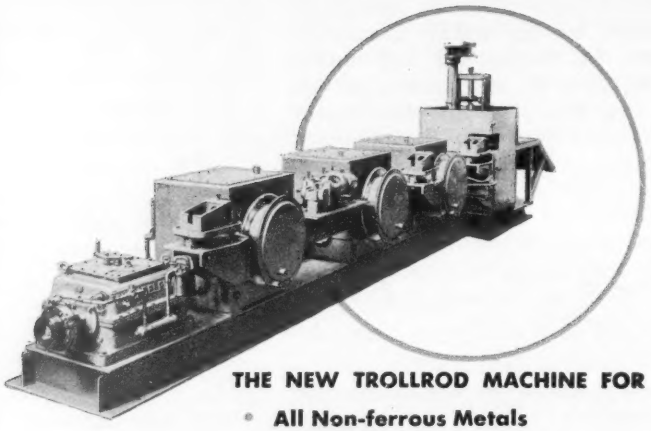
SUPPLYING DEPT. ..... DATE ..... CONSUMING DEPT. .....

From rod size	Steel description	Special notes	Req'd. wire size	Balance due on all orders	Amount usable next 24 hours	Stock on hand 7 A. M.	Wanted beginning 7 A. M.	3 P. M.	11 P. M.	7 A. M.	3 P. M.	

Fig. 4. DAILY STOCK REQUIREMENT

SYNCRO

THESE OUTSTANDING DEVELOPMENTS, DESIGNED AND BUILT BY SYNCRO—are all in active operation in leading wire plants throughout the world. Added to the SYNCRO complete line of machinery for the wire industry, there's a unit for every production requirement whether standard or special.

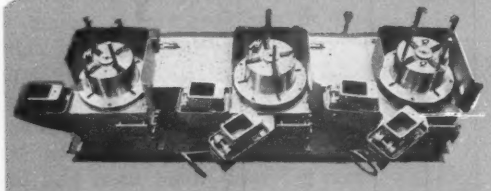


THE NEW TROLLROD MACHINE FOR

- All Non-ferrous Metals
- Heavy Rod Drawing
- Round or Shaped Trolley Wire Manufacture

LATEST CONTRIBUTIONS TO

THE NEW TROLLROD MACHINE • HIGH SPEED STRANDER • THREE BLOCK



3 BLOCK VERTICAL TROLLROD

- Operates in Tandem or Single Hole
- Processes Copperweld and Non-Ferrous Metals
- Adaptable for Combined Shaving and Drawing

WET CONTINUOUS FINE WIRE DRAWER

- Draws Wire as fine as .008" from maximum entering gauge of .090" in high or low carbon steel wire, non-ferrous materials or their alloys.

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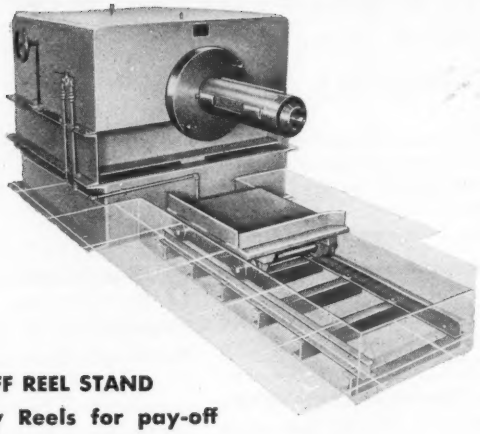


PAY-OFF REEL STAND

Loads Heavy Reels for pay-off

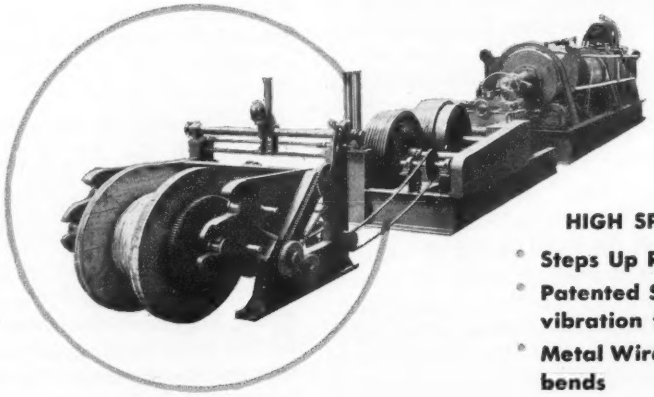
- **without Overhead Cranes**
- **without Pick-up Grapples**

SYNCRO

SYNCRO'S COMPLETE LINE OF MACHINERY FOR THE WIRE INDUSTRY INCLUDES—**Wire Drawing Machines — Stranders, Closers, Cablers, Tapers, Juters — Compound Tanks — Capstan Sections — Pay Offs — Respoolers — Heavy Duty Take Ups — Coilers — Wire Covering Machines — Portable Cut-Off Machines — Electric Rod Pointers — Die Stringing Machines — Wire Rope Machinery — Magnetic Slip Clutches — Special Machinery.**

THE WIRE AND CABLE INDUSTRY

VERTICAL TROLLROD • FINE WIRE DRAWING MACHINE • PAY-OFF REEL STAND



HIGH SPEED TUBULAR STRANDER

- **Steps Up Rotor To 500 R.P.M.**
- **Patented Simplified Rotor gives smooth vibration free operation**
- **Metal Wire Guide Shoes eliminate sharp bends**

STANDARDIZE ON SYNCRO

There's a standard Syncro Machine for every wire drawing need, from rod to fine wire — from strands to heavy cable.

LABOR RELATIONS

By John B. Stone

Washington, D. C.

The eighteenth in a series of articles on the subject, with particular reference to problems of the wire and wire products industry. The author is a noted authority on the subject.

"BIG Labor" has worked out a blue print which will be its basis of operations in wage negotiations this winter. In case of continued inflationary trends, it will serve as the argument for the fourth round of wage increases. Should "readjustment" set in before the negotiations begin, it will be used to back up demands for a continuation of present wage levels when prices begin to fall.

* * *

MANUFACTURERS of Wire and Wire Products can get a glimpse into the nature of their next wage sessions with organized labor by a study of the blue print.

* * *

ITS general features have been adopted by both AF of L and CIO national offices here. It has been put in most succinct form by the CIO in its most recent issue of "Economic Outlook".

* * *

IN general terms the blue print argues that after each of the first three rounds of wage increases following World War II, industry increased prices by much more than was necessary to meet the wage increase. These price increases led to record profits. Labor argues, and will demand at future negotiations, that these profits have been so great that industry can grant a new round of wage increases without upping profits, by simply handing over a slice of the profits to its employees.

* * *

THE CIO claims that a study of wages, prices and profits in the general period of the first round wage increases, early in 1946 shows the following: straight time hourly earnings in the fourth quarter of 1946 had risen to $1.10 from $0.95 in the fourth quarter of 1945, an increase of 16 per cent. During these period wholesale prices of semi-manufactured goods rose 31.6 per cent, but the Federal Reserve reported profits of 629 corporations rose 75.9 per cent during the same period.

* * *

LABOR leaders insist these figures demonstrate that prices charged by these corporations increased much more than costs including labor costs and that this increase accounted for the substantial upturn in profits.

* * *

CIO economists claim much the same thing happened in the second round. They quote government figures to show that between the fourth quarter of 1946 and the fourth quarter of 1947 average straight time hourly earnings increased from $1.10 to $1.22½, an increase of 11.2%. But wholesale prices increased 22.1 per cent during that period and profits of manufacturing companies increased 29.3 per cent.

* * *

THE CIO economic thinkers claim that the third round of wage increases now being completed is being followed by another "unjustified" round of price increases which more than off-set the size of the wage boosts.

* * *

THE Bureau of National Affairs, a private research organization of recognized authority here reports on this third round that between Jan. 22, 1948 and June 22, 1948 that in 1,258 wage settlements, increases of from 5 to 10 cents were reported in 422 cases; increases of from 10 to 15 cents in 528 cases and increases of more than 15 cents in 308 cases.

* * *

BUT to counteract these increases, the CIO digs up current price increases which they claim "nullify" the wage increases by increasing the cost of living.

* * *

AMONG the price increase citations are; automobiles, electrical supplies with General Electric listed for price boosts of 5 to 12 per cent of consumer items steel, other durable goods, oil, and food.

* * *

AT the same time, to fill out the picture of the third round, the CIO economists list a host of profits figures for the first six months of 1948 compared with the first six months of 1947. These figures show profit situations ranging from an increase of 141 percent for Skelly Oil and 130 for Universal Consolidated Oil to decreases of 16.6 per cent for Allegheny Ludlum Steel and 14.4 per cent for Florence Stove but the trend is substantially upward.

* * *

A major point in the presentations of both the AF of L and the CIO and many of their individual unions is a demand for price control so that "wages can catch up with prices".

* * *

BUT informed observers here for the most part regard this tactic as a political gesture in the campaign and look between the lines to find the real meaning of the presentations, which, they are convinced, will be found in the actions of negotiators at the next wage sessions.

* * *

MAJOR exceptions to the general rule as evidenced in these blue prints, will be the companies

(*Please turn to page* 993)

New Materials for Wire and Cable Applications

By H. L. Wuerth, Geon Sales Representative

B. F. Goodrich Chemical Company
Cleveland, Ohio.

A new plastic material for wire and cable insulation. A paper presented before the Wire Association at Pittsburgh, Pa., October, 1948.

IT is well recognized that the wire and cable industry is a key factor in the fast moving industrial world in which we all live and work today. The requirements of the wire industry have, therefore, placed great responsibility on the chemical industry to supply increasing quantities of improved materials for electrical insulation and protective coatings. This responsibility is recognized by the company I represent and I, therefore, wish to thank you for this opportunity to talk to the members of the Wire Association.

* * *

YOU are all familiar with the achievements, particularly in these last ten years, which have brought about the use of synthetic polymers in the electrical wire and cable industry. Today, the industry employs a host of well-proven materials chemically defined and classified, often to the dismay and confusion of technical men and laymen alike. Do not lose courage — this is only the beginning — there are many more to come. A few examples of the well-proven types — the stryene — butadiene copolymers — better known as GR-S, neoprene, acrylonitrile — butadiene types such as Hycar, polyethylene and the polyvinyl chloride elastomers such as Geon Plastics. These and others have gained their special places and are now standard materials in the wire industry.

* * *

WIRE engineering is becoming more specialized and the requirements more stringent. The complexities of modern machines — ranging from household appliances to jet engines — require more efficient wire insulation and protective coverings, incorporating a multitude of electrical and physical properties. These demands include the necessity for higher operating temperatures, chemical inertness, flame resistance and many others. In addition to these, we must also consider such factors as the desire to keep insulation thickness at a minimum. The Armed Services want cable coverings which will flex at -70° C., others to withstand operating temperatures of 160° C. Radio and electronic equipment is being designed to operate over wider temperature ranges with the need for compactness placing greater demands on the efficiency of wire insulation. The development of jet propelled aircraft and guided missiles has created needs almost beyond comprehension.

* * *

WITH such requirements, we must give free reign to our talents and resources, and I would, therefore, like to describe briefly some new materials which possess combinations of properties which are of interest in light of the previously mentioned requirements.

* * *

THE first of these is a colloidal dispersion of modified vinyl resin in water containing 55% total solids and designated as **Geon Latex 31X.** This material can be air dried, or processed with a very nominal amount of heat, to produce strong flexible films containing no plasticizer and have low moisture vapor transmission. Such a material is of interest for protecting fibrous braid coverings because of its ease of processing, unlimited color range, oil and grease resistance and flame resistance. In the same family, are several other latices requiring fusion temperatures in the range of 250° F. to secure maximum film properties. These are well suited for thin wall insulation on fine wire sizes which are difficult to coat by the extrusion process.

* * *

THE second type, is a class of materials combining the oil, chemical and age resistant properties of polyvinyl chloride with the solvent resistance and flexibility of Hycar nitrile rubber. This material, **Geon Polyblend**, is a colloidal blend of the two materials which offers the electrical industry some unique advantages for both jacket and low voltage primary insulation applications. Because of its dual nature, it can be compounded in three major categories:—

1. **Used as a thermoplastic similar to a vinyl.**
2. **Formulated so as to respond to vulcanization.**
3. **It can be used to modify either a conventional polyvinyl chloride type plastic, or a nitrile rubber compound.**

* * *

THE nitrile rubber phase functions as a plasticizer for the polyvinyl chloride and displays two outstanding features. First — since it is non-volatile, compounds suffer very little weight loss, or plasticizer loss during prolonged heating. Second — the tendency for plasticizer migration is eliminated. Migration is encountered in some cases with liquid plasticized vinyls and tends to destroy the electrical properties of the primary insulation.

* * *

COMPOUNDS based on Polyblend are, therefore, well suited for high frequency cable jackets such as radar cables employing polyethylene as primary insulation. As low voltage insulation for ap-

pliance cords, polyblend again insures no ill effects from plasticizer migration attacking painted, or varnished surfaces.

* * *

THE examples cited for the two types of material just described offer the wire processor further opportunity to "tailor-make" his products for specific end uses.

* * *

LET us now consider a most significant new material for wire and cable applications. This is being produced by the B. F. Goodrich Chemical Company and is still in the development stage. This is a new elastomeric polymer of an acrylic acid ester designated as **Hycar PA.** It is most interesting since it exhibits outstanding resistance to flexing, sunlight and ozone. In the cured state it shows heat resistance intermediate between the best of the conventional rubbers and the silicones.

* * *

THE polymer is responsive to a unique vulcanization process which converts this chemically saturated thermoplastic polymer to a thermoset, or "cured" product. It may be compounded in conventional rubber processing equipment, using compounding ingredients and techniques similar, in general, to those employed for other rubbers. The uncompounded material is thermoplastic and temperatures above 300° F. soften it to the point of flow. Unlike natural crude rubber, Hycar PA regains most of its nerve upon cooling. Only very prolonged heating — (two or three months) — will cause the material to turn brown and harden. By varying the amount of loading, or curative and loading, cured stocks in a hardness range from that of soft gum to hard rubber can be produced.

THE properties of typical compounds are indicative of its potentialities in wire and cable applications:—

TEAR resistance — Crescent tear of 250 - 300 lbs. per inch.

* * *

OZONE resistance — No cracking apparent after 500 hours exposure to concentration which causes crude rubber to crack in a few minutes.

* * *

FLEXING resistance — Stocks reinforced with carbon black flexed 15 - 18 million times without failure. Scored cuts did not grow.

* * *

ULTRA-VIOLET resistance — Eleven days exposure in the Fadeometer — (approximately equivalent to four years in sunlight) — caused no visible change.

* * *

GAS diffusion — Cured Hycar PA is twice as resistant as conventional rubbers to diffusion of air, nitrogen, hydrogen and oxygen.

* * *

SOLVENT resistance — Excellent resistance to heavy oils, kerosene, cottonseed oil, glycerine, mineral oil and fats. Not resistant to alcohol, or ester type solvents. The water resistance varies depending upon the type of curative used. Compounds cured with litharge display good water resistance and fair insulation resistance values can be obtained in the conventional water immersion tests. The use of sizeable quantities of sodium silicate type curatives will impair the water resistance.

* * *

HEAT resistance — A typical heat resistant compound of cured Hycar PA exhibits about 40% depreciation in elongation and practically no change in tensile strength after heat ageing in air for 30 days at 300° F. Shore hardness — (Duro A scale) — displayed a change from original value of 76 to 87 on the same compound after the 30-day test.

* * *

ELECTRICAL properties — Specimens tested in air at 70° C. after conditioning one hour at 95° C.

Volume resistivity	**190×10^9 ohm-cms**
Dielectric constant at 60 cycles per second	**4.05**
Power factor at 60 cycles per second	**2.17**
Loss factor at 60 cycles per second	**0.088**
Dielectric strength at room temperature on 15 mil sample	**715 volts per mil**

Test slabs .075 inches thick withstood 15,000 volts indefinitely at 300°F.

* * *

THE technology of compounding and extruding polyacrylic rubber is still relatively undeveloped, but the previously mentioned demands for high temperature materials are spurring development work. Hycar PA insulated wire is already under field tests and indications are that it will gain an important position in the wire industry.

* * *

ALL of these materials have come into existance within the last two years and are examples of the many approaches being used to attack the problems which confront the wire industry.—(We have barely scratched the surface of a great source of chemically synthesized materials). — The rapidly expanding research facilities of the chemical industry coupled with the ever increasing fund of knowledge and experience will yield new and improved materials for the wire processor.

THE WIRE ASSOCIATION MEDAL AWARD

For the Most Meritorious Paper on Wire Manufacture or Fabrication During the Year
BY A MEMBER OF THE WIRE ASSOCIATION —

ALL members of the Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association Convention.

* * *

AN annual medal will be awarded for the papers coming nearest to the requirement set forth above.

* * *

CONSIDERATION for the Medal Award is not limited to the papers presented or the Annual Meeting, but is given to all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the year.

* * *

ALL papers submitted become the property of the Wire Association and the Board of Directors constitutes the Committee on Awards.

* * *

SELECTION of papers to be presented at the Annual Convention rests in the hands of the Joint Program Committee and the Board of Directors of the Wire Association.

Evaluation of Pickling Inhibitors from the Standpoint of Hydrogen Embrittlement

By C. A. Zapffe and M. E. Haslem
Consulting Metallurgist Research Chemist
Baltimore, Md.

I. Acid Pickling of Stainless Steel*

SUMMARY

BY means of a special bend test, the field of commercial pickling inhibitors is surveyed from the standpoint of hydrogen embrittlement incurred during the pickling of stainless steel in sulfuric acid.

* * *

SEVERAL grades of stainless steel are studied, and thirteen marketed inhibitors, plus one inhibitor-base. Of these fourteen reagents, eleven by their presence in the pickling solution cause *greater embrittlement* than that incurred by pickling in raw acid; two neither increase nor decrease embrittlement beyond that caused by uninhibited acid; and only one, and that but slightly, affords an improvement.

* * *

SINCE these results are attended by the customary great decrease in metal attack, hence in total hydrogen evolved, they are particularly surprising; and they open new fields both for research in inhibitor theory and for practical applications in the plant.

* * *

TO correct the demonstrated inadequacy of present marketed inhibitors in the acid pickling of stainless steel, new reagents are being developed; and two preliminary compositions having considerable promise are studied.

This is the first of three papers covering the evaluation of pickling inhibitors from the standpoint of Hydrogen Embrittlement.

This first paper relates specifically to acid pickling for Stainless Steel. The second paper relates to acid pickling for Carbon Steel. The third paper discusses tests conducted under conditions of Cathodic Pickling and compares the results with those previously obtained from the same steels and same reagents under conditions of acid pickling.

These three papers will be presented in the form of a lecture before the Wire Association at Pittsburgh, Pa., October, 1948.

INTRODUCTION

SEVERAL years ago the present authors reported the development of a bend test particularly suited to the study of embrittlement phenomena in wire[1]. The test was applied to preliminary measurements of the sensitivity of stainless steels to pickling brittleness. It was determined that those grades of stainless steel which are hardenable by heat treatment are particularly liable to this type of brittleness, which is caused by the absorption of hydrogen gas by the metal during the pickling process. The grade referred to commercially as Type 440-C, containing approximately 17 per cent chromium and 1.0 per cent carbon, proved most susceptible; and that steel was therefore selected as a standard sensitive indicator for studying such variables in embrittlement as acid composition, temperature, duration of pickle, effect of coldworking and heat treatment, and so forth[2], [3].

* * *

IN the course of the study, several commercial pickling inhibitors were added to the bath because they were advertised and popularly understood to minimize or to prevent hydrogen embrittlement. Such a claim seemed a logical one, even in the absence of direct test, because the development of hydrogen depends upon metal attack, which is greatly reduced in the presence of any of these reagents.

* * *

TO the considerable surprise of the investigators, the bend test immediately disclosed that the presence of these reagents did **not** reduce the embrittlement of the Type 440-C steel wire; but — to the marked contrary — often made the embrittlement **much worse** than that resulting from pickling in raw acid. While the behavior of the several reagents differed, not one of the half dozen tested improved pickling brittleness.

* * *

*Investigation conducted in conjunction with a research program on gas-metal systems under the sponsorship of the Office of Naval Research.

Papers II and III will be published in the November and December, 1948 issues of WIRE AND WIRE PRODUCTS, respectively.

These three papers will be presented in the form of a lecture before the Wire Association at Pittsburgh, Pa., October, 1948.

THIS was a surprising disclosure which required an immediate further exploration to find whether the results were true (1) for all commercial inhibitors and (2) for all steels. It seemed inconceivable that such a prominent effect could have gone so long unrecognized. Pickling inhibitors are primarily designed for the pickling of carbon steel, of course. On the other hand, the suggestion is rarely made that the grade of steel influences the selection of an inhibitor. Inhibitors are generally prescribed from the standpoint of the characteristics of the acid used.

* * *

IN a series of three papers, these issues are now explored; and in the present paper we consider the first aspect, extending the particular study with stainless steel to cover in greater completeness the field of commercial inhibitors.*

* * *

TEST CONDITIONS

Pickling Solution

EACH test was separately performed in a renewed 200-cc. portion of pickling solution made to 10 per cent by volume of c.p. H_2SO_4 in distilled water. Temperature was held within 2° of 77°C (170°F); and the pickling time was fixed at exactly 15 minutes.

* * *

AS for the commercial reagents, these were added to the pickling solution in carefully measured quantities, as shown on the graphs to follow. Dosages interpolated, and then extrapolated to great excesses, the proprietary addition commonly recommended by the manufacturer. In some cases a specific recommendation was received for pickling stainless steel; though, as just mentioned, these reagents are commonly prescribed on the basis of the pickling solution, and not the type of steel. The reagents, referred to in the text only as Reagent I, II, III, etc., are listed in the Appendix along with their recommended proprietary additions. While there are undoubtedly other popular reagents on the market, those considered here cover by far the major portion of the industry and represent as exhaustive a survey as is convenient to make.

Steel

IN Table I the several types of stainless steel are described which served as specimens. Type 440-C was used throughout as a standard, two coils being used from heats differing slightly in analysis, and hence in susceptibility to embrittlement. Two other less-sensitive grades, Types 410 and Type 431, were also used occasionally to demonstrate that the results are generally applicable to stainless steel.

Procedure

DUPLICATE wire specimens were carefully cleaned as described in the original paper[1], immersed for 15 minutes in the solution, removed, briefly rinsed, dropped in ice water, and tested in 30″ and in 90″, respectively, after leaving the pickle. The angle of bend at which each wire failed, if it did fail, is recorded on the graphs as a large circle for the 30″ specimens and a small circle for the 90″ duplicate. If failure did not occur, a bend of 180 degrees is indicated. **An angle of bend of 180 degrees does not mean the absolute absence of embrittlement;** but it means that the embrittlement, if any, is not measurable by this test.

* * *

EACH series of tests began with a "blank" pair of values for pickling in raw acid with no inhibitor added — the circles along the ordinate at the left of the graphs. The course of points moving from this "blank" toward the

TABLE I

Description of Stainless Steel Specimens*

AISI Type No.	Analysis	Thermal Treatment	Mech. Treat. (% Red. Area)
410	Cr = 12.52 C = 0.125 S = 0.023 P = 0.020 Si = 0.36 Mn = 0.45 Ni = 0.29	Hardened Salt Bath at 1800°F oil-quenched Stress-Relieved 730°F — 25 min. water-quenched	26.0
431	Cr = 16.34 Ni = 1.68 C = 0.159 S. = 0.033 P = 0.020 S. = 0.51 Mn = 0.56	Hardened (Cooled from 2000°F in water-jacketed tube, wire passing 10 ft./min.)	17.5
440-C (Coil II)	Cr = 17.08 C = 1.08 S = 0.016 P = 0.016 Si = 0.15 Mn = 0.48 Ni = 0.28 Mo = 0.52	Annealed 1550°F — 3 hrs. 25°/½ hr. to 1200°F Air cool	29.0
440-C (Coil III)	Cr = 16.79 C = 1.01 S = 0.020 P = 0.021 Si = 0.49 Mn = 0.42 Ni = 0.23 Mo = 0.56	Annealed (Same as preceding)	24.5

* All wires 0.060″ ϕ

*Pickling inhibitors are primarily designed, as the reader knows, to reduce metal attack and acid loss. The present study in no way concerns an evaluation of the inhibitors on the basis of these two most important aspects, but ONLY on the basis of a third less prominent and less recognized aspect — hydrogen embrittlement.

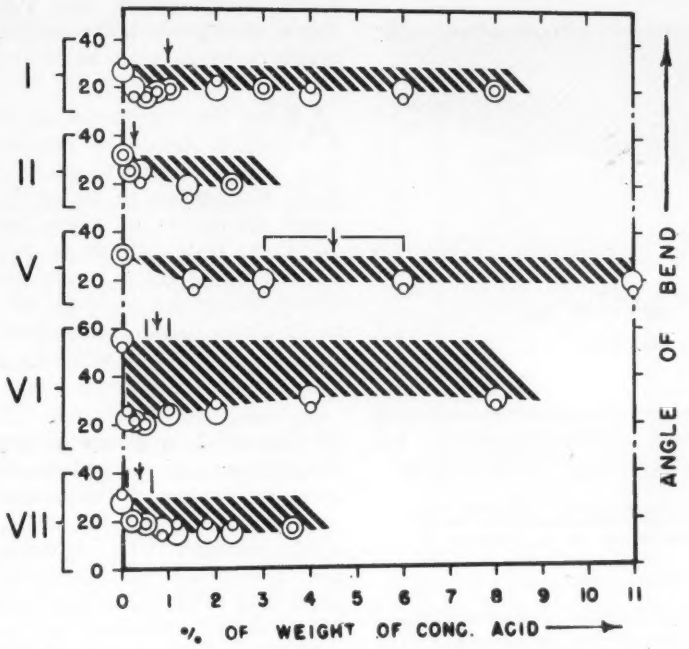


Fig. 1. — Bend values for inhibitors which increase embrittlement. Pickling of Type 440-C stainless steel wire in uninhibited acid causes failure at the "blank" angle designated along the ordinate on the left. Addition of Reagents I, II, V, VI, or VII then further decreases the bend angle as indicated by the shaded areas. Arrows denote proprietary additions. * * *

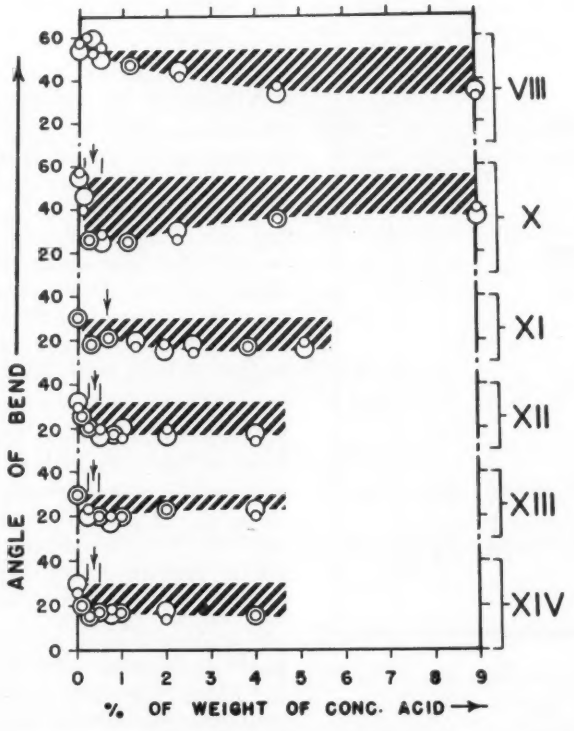


Fig. 2. — Continuation of preceding figure, showing the individual effects of Reagents VIII, X, XI, XII, XIII, and XIV * * * *

right on all graphs then indicates the course of brittleness as affected by an increasing inhibitor content.

* * *

TO aid in picturing the effect of a given reagent across the whole range of concentration studied, shading is marked on the graph with respect to a horizontal extension of the "blank" bend value. Recommended proprietary additions are also designated to make clear the range of the tests with regard to pickling practice.

RESULTS

OF the total of sixteen reagents examined, (thirteen marketed inhibitors, two specially designed inhibitors, and one inhibitor-base) all can be placed conveniently in one of three broad classifications:

I. **Reagents which increase embrittlement**
II. **Reagents which do not alter embrittlement**
III. **Reagents which decrease embrittlement**

Reagents Which Increase Embrittlement

BY far the greater number of the inhibitors fall into Class I, causing by their presence even greater embrittlement than follows from pickling in the raw acid.

* * *

IN Figure 1, Reagents I, II, V, VI, and VII are seen uniformly to cause a sudden sharp drop in angle of bends, indicating that their presence in the pickling bath causes greater embrittlement than that following from pickling in raw acid.

* * *

THAT is, a 15-minute pickling treatment at 77°C (170°F) in 10% H_2SO_4 solution causes the Type 440-C stainless steel wire (Coil II) to break at an angle of bend of approximately 30 degrees; whereas proprietary additions, and less, of these inhibitors cause the wire to break at only 20 degrees of bend, and less. Nor does a great excess of inhibitor in any case cause a return of the bend angle even to that for the raw acid. The shaded area measures the **additional embrittlement** caused by the presence of the inhibitor.

* * *

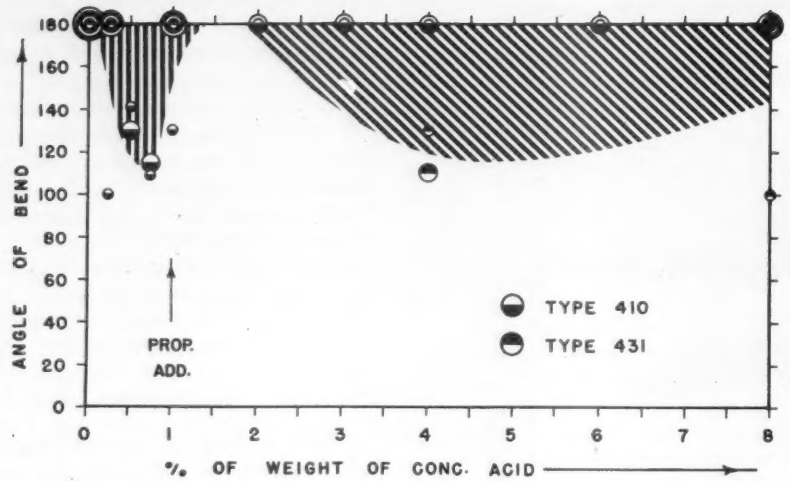


Fig. 3. — Tests of preceding figures repeated using two different grades of stainless steel. Both Type 410 and 431 withstand the pickling test without measurable embrittlement in raw acid; but with inhibitor added — here Reagent I — embrittlement sets in as indicated by the shaded areas. * * * * * *

ALL wire specimens were from Coil II of Type 440-C listed in Table I, except for Coil III used with Reagent VI. The difference in the two heats of steel shows here as a blank value lying near 55 degrees of bend for the tests with Reagent VI, dropping to values between 20 and 30 degrees of bend as the inhibitor is added.

* * *

THESE results are especially remarkable when one considers that every reagent tested decreased metal attack as advertised. The phenomenon must therefore concern a previously unrecognized surface activity of these reagents which, at least in the case of stainless steel, causes vastly greater proportions of hydrogen to be absorbed by the metal with respect to total hydrogen produced. The phenomenon in itself is not unknown, a similar activity having been long described[4] for certain "promoter" elements in the VI-B Subgroup of the Periodic Table, among which are arsenic and sulfur[1].

* * *

AS for the importance of the effect, it should be pointed out that a decrease in angle of bend from 30 degrees to 15 or 20 degrees represents a severe loss in ductility. It is difficult to produce embrittlement in a metal which causes failure at an angle of bend much less than 15 degrees, for such a condition is virtually glass-like.

* * *

IN Figure 2, a group of popular inhibitors from a single manufacturer is depicted. These are Reagents VIII, X, XI, XII, XIII, and XIV. Reagent VIII, however, is not a commercial composition in itself, but is rather a base reagent from which inhibitors are made. Accordingly, no proprietary addition is indicated for it.

* * *

AS in the preceding figure, embrittlement increases with addition of the inhibitor, and to a comparable extent. Reagents VIII and X were tested with Coil III; the others with Coil II.

* * *

AS a further check on these disclosures, two additional grades of stainless steel were tested whose compositions differ substantially from that of Type 440-C. These are Types 410 and 431, the first containing only 12.5% chromium, and the second 16% chromium with 1.7% nickel added. Both have carbon contents at the opposite end of the range from Type 440-C, and similar to that of mild steel. (See Table I.)

* * *

IN fact, pickling in raw acid according to the present test **causes no measurable embrittlement** of either steel, all blank values being 180 degrees. Yet, the addition of an inhibitor **initiates measurable embrittlement**, as shown in Figure 3.

* * *

HERE Reagent I has been added. The Type 410 wire breaks with early additions of the inhibitor, the effect being a maximum close to the proprietary concentration.

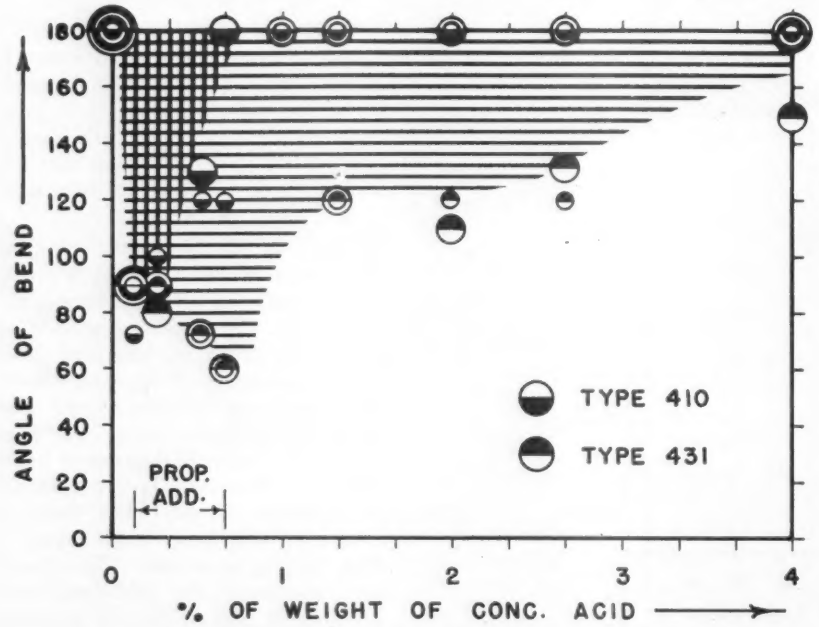


Fig. 4. — Tests of Figure 3 repeated using Reagent VII. Again, steels which show no embrittlement from pickling in raw acid develop embrittlement as shown when this inhibitor is added. * * * * * *

Excesses then bring a return to 180 degrees. Perhaps this is a reflection of the very slight upswing indicated for this reagent in Figure 1.

* * *

PECULIARLY, Type 431 resists measurable embrittlement until greater excesses are added; but then it follows a similar course, indicated by the shaded area on the right. While the difference between the reactions of the two grades is not understood, their general activity provides striking agreement with the previous disclosures, particularly because in raw acid neither steel shows any measurable embrittlement at all.

* * *

IN Figure 4, these same steels are depicted again for tests with Reagent VII. A similar behavior displays itself in that both steels develop measurable embrittlement **only** in the presence of the inhibitors, and that the embrittlement of Type 431 persists at much higher concentrations of reagent than for Type 410. A point of difference stands in the fact that both steels now develop susceptibility more or less simultaneously within the range of the proprietary concentration.

Reagents Which Do Not Alter Embrittlement

AMONG the sixteen reagents, two were found which neither increased nor decreased embrittlement beyond that caused by pickling in raw acid.

* * *

IN Figure 5, Reagents III and IV show no effect whatsoever upon the embrittlement of Coil II of Type 440-C, though tests with Reagent III repeated with Coil III (middle set of points on graph) possibly disclose a slightly increased embrittlement within a range just exceeding the proprietary addition. The reason for the discrepancy between the two curves for Reagent III is not known; but the embrittlement of Coil III is still considerably less than that shown in Figures 1 and 2, which perhaps allows the reagent to be classed as given.

* * *

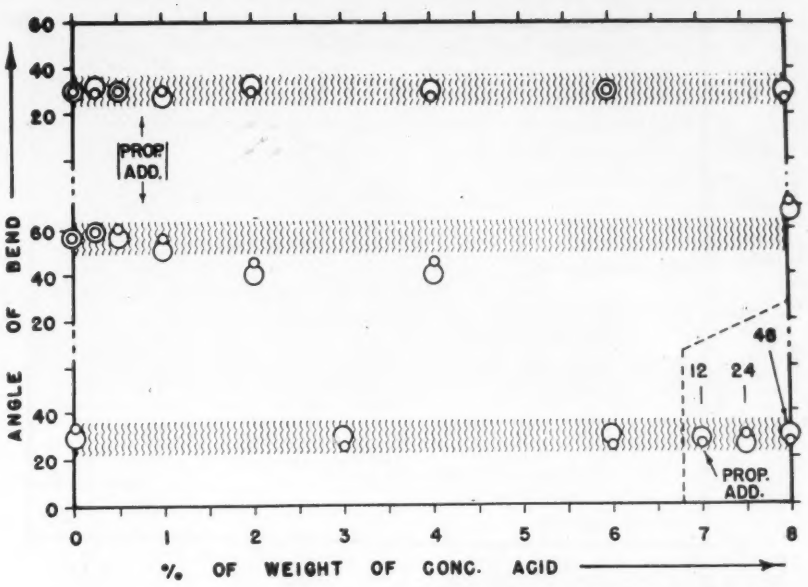


Fig. 5. — Bend values for inhibitors which do not alter embrittlement. Reagents III (top) and IV (bottom) neither improve nor worsen the condition of embrittlement caused by pickling in raw acid. A duplicate test (center) with Reagent III and Type 440-C wire from another heat (Coil III) possibly indicates slightly increased embrittlement in a certain range of concentration. * * * * *

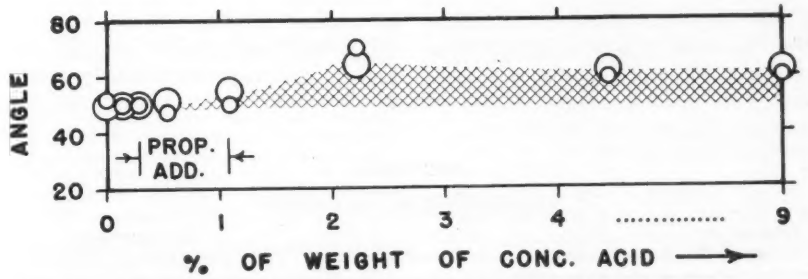


Fig. 6. — Bend values for Reagent IX. This is the only marketed inhibitor studied which gave any indication whatsoever of improving the condition of embrittlement over that caused by pickling in raw acid, and its action is extremely slight. * * * * * *

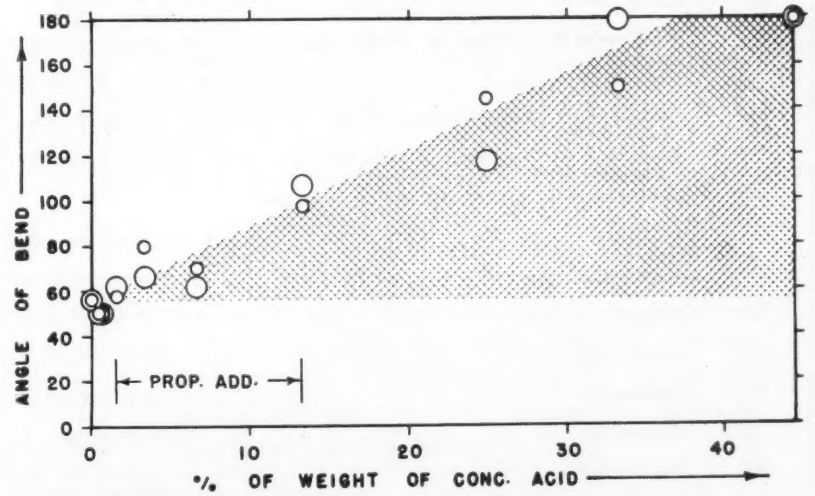


Fig. 7. — Behavior of the special inhibitor for stainless steels, Reagent XV. The ductility improves and continues to do so until a bend of 180 degrees is regained. * * * *

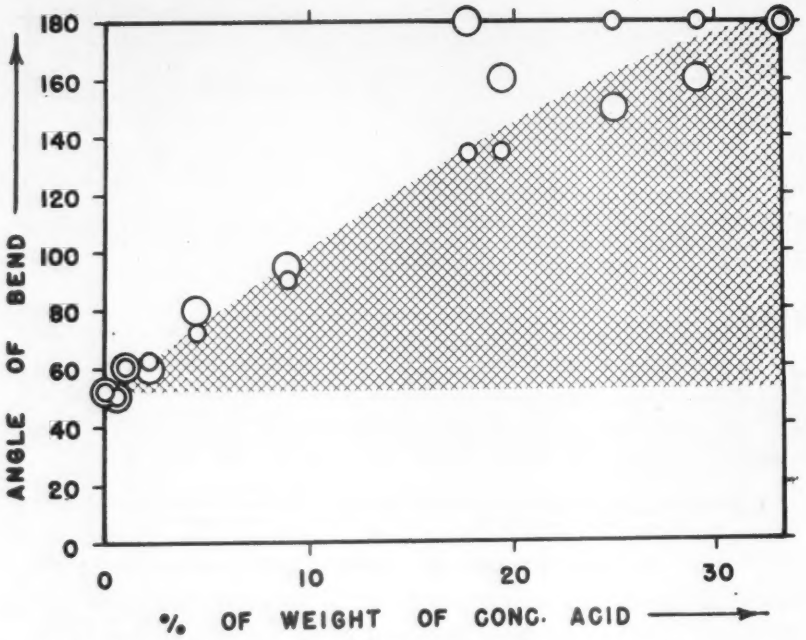


Fig. 8. — Behavior of the special inhibitor for stainless steels, Reagent XVI. The ductility improves consistently until a full bend of 180 degrees is regained. * * * * *

ON the other hand, while there is some practical significance in the different behaviors of the first and second classifications of inhibitors, the distinction may have no more fundamental significance than that the **proportionality factor** of dissolved hydrogen to total developed hydrogen is slightly **less increased** by the reagents in the second group.

* * *

THAT is, let us assume that 1000 parts of hydrogen are produced by the action of the raw acid, and that 1 part dissolves to cause the embrittlement indicated by the blank value. Then, the addition of an inhibitor from the first group reduces the total developed hydrogen, say, to only 10 parts; but of these 10, **two** parts now dissolve in the steel to increase the **proportionality factor** from 0.001 to 0.20 (200 times) and thus to increase embrittlement beyond that caused by the raw acid.

* * *

WITH inhibitors from the second group, the total developed gas may also be cut to 10, but the proportionality factor is now increased only 100 times, let us say, and 1 part of the gas enters the steel just as in pickling with raw acid.

Reagents Which Decrease Embrittlement

OF the sixteen reagents studied, thirteen were marketed products at the time of the tests. Of these thirteen, **only one,** Reagent IX, gave any indication whatsoever of improving the condition of embrittlement resulting from pickling in raw acid. Its behavior is shown in Figure 6.

* * *

BECAUSE of this single superiority of Reagent IX, slight as it is, and the fact that the manufacturer, the American Chemical Paint Company, has one of the most extensive backgrounds in the field, these results were brought to the attention of the technicians of that company for the purpose of developing an inhibitor suitable for pickling hydrogen-sensitive grades of stainless steel.

* * *

ALTHOUGH the present paper intends only to cover the range of contemporary marketed inhibitors to show the general inadequacy in the pickling of stainless steels, two preliminary compositions of a corrective nature will be dis-

APPENDIX

TABULATION OF REAGENTS

Reagent Designation	Trade Name	Manufacturer	Recommended Proprietary Addition
I	Acidex #8	W. B. B. Corporation	1% Acidex for weight of acid contained
II	Acitrol Liquid	E. F. Houghton and Co.	One part per 300 to 700 of commercial acid
III	Kelite Control	Kelite Products, Inc.	½ to 1½ by weight of lbs. pickling acid
IV	Nep Powdered Inhibitor	William M. Parkin Co.	2% by weight of the solution
V	Nep #22	" " " "	½ to 1% by weight of the solution
VI	Oakite Pickle Control #3	Oakite Products, Inc.	1% by weight of conc. H_2SO_4
VII	Pennsalt PM-40	Pennsylvania Salt Mfg. Co.	0.02 to 0.10% by weight of the solution
VIII	Rodine Base 45	American Chemical Paint Co.	—
IX	Rodine 50	" " " "	½ to 2% of vol. of conc. acid
X	Rodine 67	" " " "	¼ to 1% by weight of H_2SO_4
XI	Rodine 77	" " " "	¼ to 1% of vol. of conc. acid
XII	Rodine 107	" " " "	.25 to .55% by weight of H_2SO_4
XIII	Rodine 111	" " " "	.25 to .55% by weight of H_2SO_4
XIV	Rodine 120	" " " "	25 to .5% by weight of H_2SO_4
XV	Rodine X-1	" " " "	2.5 to 20 lbs. per 100 gals. pickling sol'n.
XVI	Rodine X-2	" " " "	—

cussed to point the way for the remedy. These are Reagents XV and XVI, specially prepared for the pickling of stainless steel. Their behaviors are depicted in Figures 7 and 8.

* * *

A proprietary addition is indicated for Reagent XV, but none for XVI. Both restore the bend angle to 180 degrees. Though complete recovery does not fall within the proprietary range for Reagent XV, both reagents in all concentrations improve the condition of embrittlement following from pickling in uninhibited acid.

* * *

FURTHER discussion of these and other special inhibitors now in process of development will be reserved for a later communication. The principal point to be made here is that two compositions have already been derived which cover the requirements of economic application, reduction of metal attack and fuming, and in addition show corrective action against hydrogen embrittlement. The importance of their contribution is better revealed in less severe tests. For example, steels such as Types 410 and 431, which are much less sensitive than Type 440-C, develop no measurable embrittlement in the presence of these inhibitors, in marked contrast to the results shown in Figures 3 and 4. And when the pickling period is reduced from 15 to 10 minutes in tests with Type 440-C, the blank value of approximately 90 degrees of bend for raw acid **does** return to 180 degrees when proprietary quantities of these reagents are added. All other reagents here studied would either reduce the blank angle of 90 degrees to lower values, or would leave it unaltered, as attested by Figures 1, 2 and 5. In certain critical instances of wire breakage in the plant, then, the application of Reagent XV or XVI could correct the problem.

Conclusion

IN summary, the principal points of this investigation are as follows:

1) **Thirteen of the most popular commercial pickling inhibitors, plus one inhibitor-base, have been studied from the particular standpoint of their effect upon hydrogen embrittlement during the pickling of stainless steel in sulfuric acid;**

2) **Of these fourteen reagents, eleven cause greater embrittlement by their presence in the acid than that caused by pickling in the raw acid itself;**

3) **Two neither increase nor decrease the degree of embrittlement caused by pickling in uninhibited acid;**

4) **Only one causes any improvement, whatsoever, and that but slightly;**

5) **Among the eleven which increase embrittlement, the effect shows as an immediate decrease in the angle of bend sustained by Type 440-C (17% chromium — 1% carbon) stainless steel wire when the inhibitor is present in the solution; and by the appearance of embrittlement where none was measurable before in the case of less susceptible grades, such as Type 410 (12% chromium) and Type 431 (16% chromium — 1.5% nickel);**

6) **Since these results are accompanied by a customary great decrease in metal attack, hence in total hydrogen produced, they must be based upon a great increase in the proportionality factor for hydrogen dissolving in the metal vs. total hydrogen produced — a matter of subtle surface chemistry not yet understood;**

7) **Two preliminary compositions for special inhibitors have been derived which point the way to correcting the problem of pickling brittleness with susceptible stainless steels.**

IN closing, attention is drawn to the fact that the present results apply strictly only to the described tests, and therefore only to the stainless steels. A second manuscript in this series will consider the specific problem of pickling plain carbon steel, for which the reagents under consideration were primarily designed.

Acknowledgment

ACKNOWLEDGMENT is made to the Office of Naval Research for its support of a program of research on gas-metal systems from which the present paper stems as a special study.

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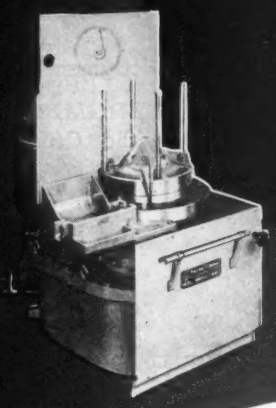

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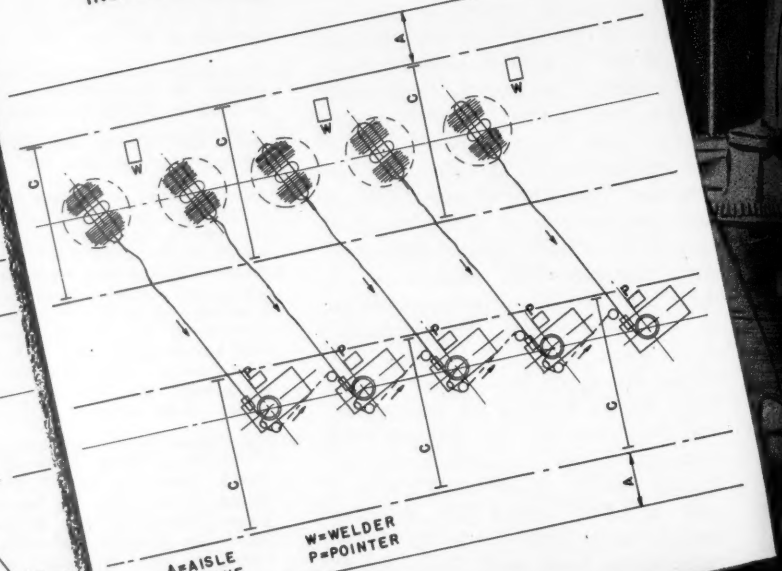

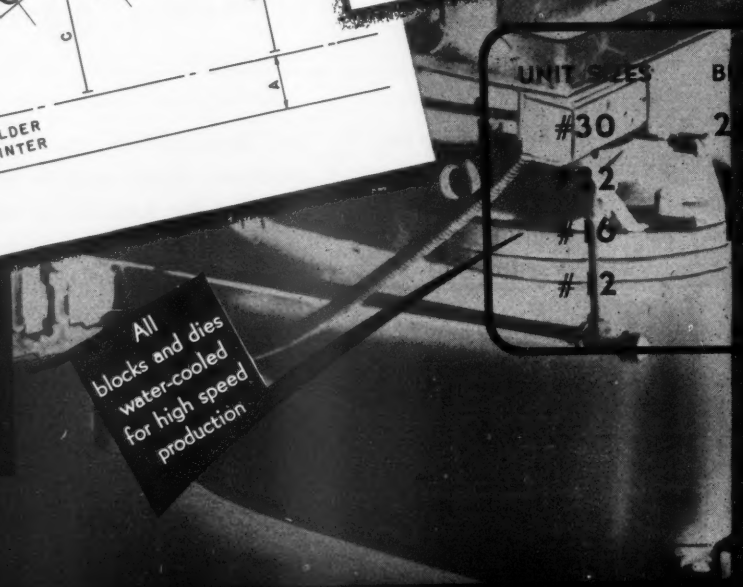

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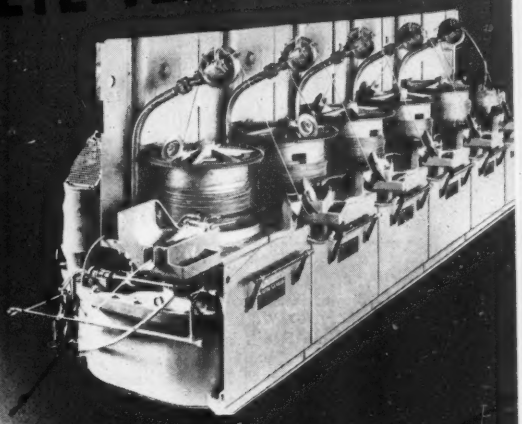

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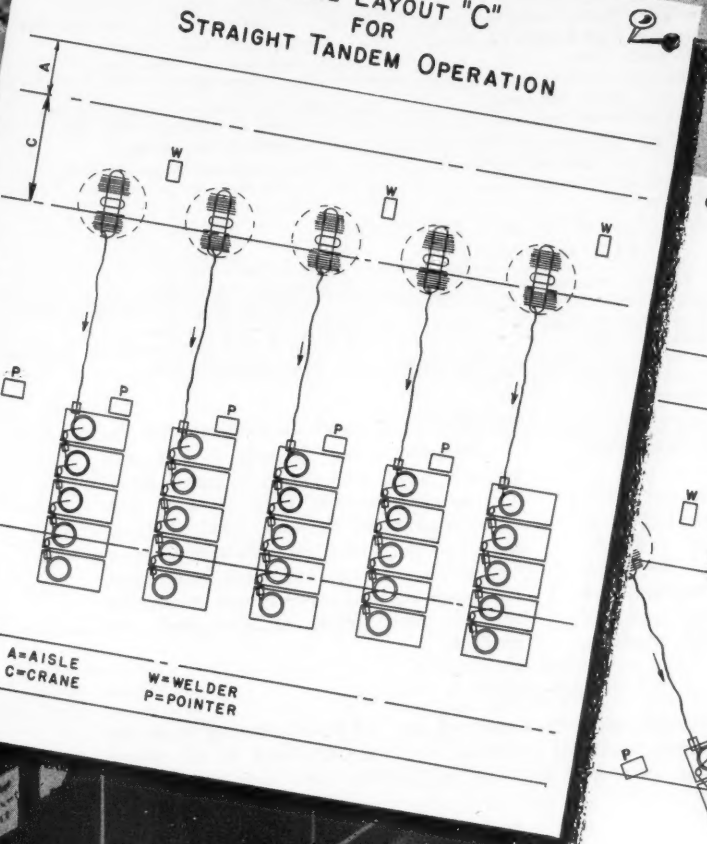

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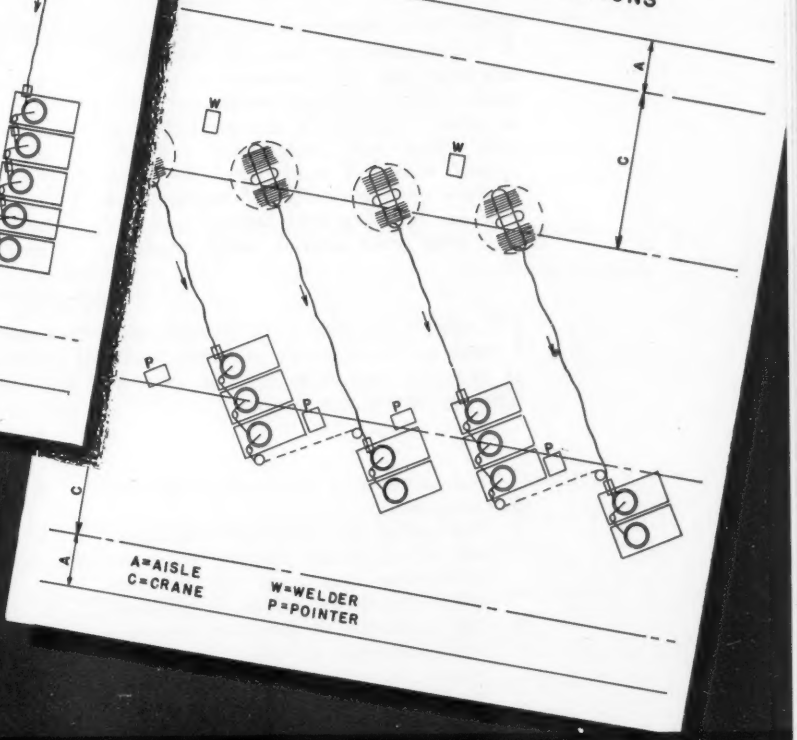

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Mrs. R. S. Spengel, Secy.-Treas., WIRE & WIRE PRODUCTS

— The Technical Sessions —

RESEARCH PAPERS ARE REPRINTED IN THE OCTOBER ISSUE OF WIRE AND WIRE PRODUCTS

The Discussions and the Mordica Memorial Lecture Will be Printed in the January, 1949 Issue of Wire and Wire Products

MONDAY, OCTOBER 18

Afternoon Session—2:00 P. M.

	A. M. Reeder, Metallurgical Engineer	Jones & Laughlin Steel Corp. Pittsburgh, Pa.
	Chairman of Meeting	
PAPER: "Practical Development of Modern Wire Drawing Compounds"	by E. L. H. Bastian, Staff Engineer	Shell Oil Company New York, N. Y.
PAPER: "Fumes and Ventilation in the Wire Mill"	by Wallace G. Imhoff, President	The Wallace G. Imhoff Company, Los Angeles, Cal.
PAPER: "Practical Applications and Mill Practice with Carbide Dies"	by E. T. Miller, Die Service Engineer	Firth Sterling Steel & Carbide Corp. McKeesport, Pa.

TUESDAY, OCTOBER 19

Morning Session—10:00 A. M.

	J. K. Findley Metallurgist	Allegheny Ludlum Steel Company Dunkirk, N. Y.
	Chairman of Meeting	
PAPER: "The Control and Production of High Carbon Wire"	by Jerry G. Weiss, Supt., Patent and High Carbon Wire Dept.	Keystone Steel & Wire Company Peoria, Illinois
PAPER: "Evaluation of Pickling Inhibitors from the Standpoint of Hydrogen Embrittlement"	by Carl A. Zapffe and M. E. Haslem, Consulting Metallurgist Research Chemist	Baltimore, Md.

TUESDAY, OCTOBER 19

Afternoon Session—1:00 P. M.

PLANT INSPECTION TRIP

Wire Mill — Jones & Laughlin Steel Corp., Aliquippa, Pa.

Busses leave Hotel promptly at 1:00 P. M.

Please register for trip — Transportation $1.50

WEDNESDAY, OCTOBER 20

Morning Session—10:00 A. M.

	Col. Allan B. Dove, Superintendent	Dominion Works Steel Company of Canada, Ltd. Lachine, Quebec, Canada.
	Chairman of Meeting	
PAPER: "Wear Resistance of Wire for Wire Rope" by Reginald S. Brown	Chief Metallurgist With discussion by Geoffrey K. Rylands	Rylands Bros., Ltd. Warrington, England
PAPER: "Wire Drawing in the British Iron & Steel Research Association"	by W. Hessenberg, Head of Mechanical Working Division	British Iron & Steel Research Association London, W. I., England

Papers not received in time for preprinting will be published in the November and December issues of Wire and Wire Products.

WEDNESDAY, OCTOBER 20

1:00 P. M.

WIRE ASSOCIATION LUNCHEON — WILLIAM PENN HOTEL

THE MORDICA MEMORIAL LECTURE

C. L. McGowan, Superintendent
Rod and Wire Mill
Atlantic Steel Corporation
Atlanta, Georgia

(Members are at liberty to bring guests. Ladies are welcome)

WEDNESDAY, OCTOBER 20

3:30 P. M.	Wire Association Annual Meeting	
7:30 P. M.	Annual Dinner Stag Smoker	Hotel William Penn

THURSDAY, OCTOBER 21

Morning Session—10:00 A. M.	Rodman R. Tatnall Metallurgist Chairman of Meeting	Wickwire Spencer Steel Div. Colorado Fuel & Iron Corp. Buffalo, N. Y.
PAPER: "Formation and Properties of Martensite on the Surface of Rope Wire"	by John H. Corson, Research Engineer	John A. Roebling's Sons Co. Trenton, New Jersey
PAPER: "Quality, Quantity & Service"	by N. T. Nelson, Jr. Rod & Wire Mills	Bethlehem Steel Company Sparrows Point, Md.

THURSDAY, OCTOBER 21

Afternoon Session—1:00 P. M.

PLANT INSPECTION TRIP
Wire Mill — Westinghouse Electric and Mfg. Company
East Pittsburgh, Pa.

Busses leave hotel promptly at 1:00 P. M.
Please register for trip — Transportation $1.50

FRIDAY, OCTOBER 22

Morning Session—10:00 A. M.	Bruce W. Gonser, Research Supervisor Non-Ferrous Metallurgy Chairman of Meeting	Battelle Memorial Institute Columbus, Ohio.
PAPER: "The Processing of Brass Wire"	by Christian Witteveld	Bridgeport Brass Company Bridgeport, Conn.
PAPER: "Hot Dip Aluminum — Temperatures and Methods of Application"	by Clarence Ulschaffer, Metallurgist	Hughesville Machine & Tool Co. Hughesville, Pa.

FRIDAY, OCTOBER 22

Afternoon Session—2:00 P. M.	R. L. Simpkins Chief Engineer Chairman of Meeting	Essex Wire Corporation Detroit, Mich.
PAPER: "New Materials for Wire and Cable Applications"	by H. L. Wuerth, Geon Division	B. F. Goodrich Chemical Co., Cleveland, Ohio
PAPER: "Fatigue Testing of Wire"	by F. A. Votta, Jr.	Hunter Spring Company Lansdale, Pa.
PAPER: "A Method For Measuring Lubricant Effectiveness in Non-Ferrous Wire Drawings"	by C. B. Shopmyer, Apparatus Dept.	General Electric Co. Schenectady, N. Y.

THE WIRE ASSOCIATION MEDAL AWARDS

For the Most Meritorious Paper on Wire Manufacture or Fabrication During the Year
— BY A MEMBER OF THE WIRE ASSOCIATION —

MEDAL AWARDS

1934 — EDWARD J. P. FISHER
Metallurgist, Keystone Steel & Wire Co., Peoria, Ill.
Title of Paper: "COLD DRAWN STEEL SPRING WIRE"

1935 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "GRAIN SIZE AND ITS INFLUENCE ON THE MANUFACTURE OF STEEL WIRE"

1936 — ROBERT NOTVEST
Chief Engineer, Welding Division, J. D. Adams Mfg., Co., Indianapolis, Ind.
Title of Paper: "STEEL FOR ARC WELDING ELECTRODES"

1937 — BENJAMIN LEWIS McCARTHY
Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper:
"ABNORMAL GRAIN GROWTH AND THE ANNEALING OF LOW CARBON STEEL WIRE"

1938 — WALTER R. BLOXDORF
Metallurgist, The MacWhyte Co., Kenosha, Wis.
Title of Paper: "WIRE ROPE"

1939 — STANLEY P. WATKINS
Manager, Sales Development, Rustless Iron and Steel Corp. Baltimore, Maryland.
Title of Paper:
"THE MANUFACTURE AND USE OF STAINLESS STEEL WIRE"

1940 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Company, Atlanta, Georgia
Title of Paper:
"GALVANIZING CHARACTERISTICS OF DIFFERENT TYPES OF STEEL"

1941 — CARLETON W. GARRETT
Wire Mill Metallurgist, Jones & Laughlin Steel Corp. Aliquippa, Pennsylvania
Title of Paper:
"A BRIEF DISCUSSION ON THE MANUFACTURE OF STEEL FOR ARC WELDING ELECTRODES"

1942 — LE ROY DEVOE SEYMOUR
Asst. Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada
Title of Paper:
"SCHEDULING AND PLANNING THE WIRE MILL FOR WAR PRODUCTION"

1943 — JOHN C. AIKEN
Asst. Supt., Rod and Wire Mills, Jones & Laughlin Steel Corp., Aliquippa, Pennsylvania
Title of Paper: "DRAWING HIGH SPEED ROPE WIRE"

1944 — AUGUST R. ZAPP
Manager, Carbide Division, Firth-Sterling Steel Company, McKeesport, Pa.
Title of Paper:
"HISTORY AND GROWTH OF THE TUNGSTEN CARBIDE DIE"

1945 — MATTHEW J. DONACHIE
Technical Director of Production, Beryllium Corporation, Reading, Pa.
Title of Paper: "SOME TRAITS AND CHARACTERISTICS IN THE WORKING OF BERYLLIUM — COPPER WIRE"

1946 — NO AWARDS

HONORABLE MENTIONS

1935 — L. D. SEYMOUR
Metallurgist, Rod and Wire Dept. Youngstown Sheet & Tube Co., Youngstown, Ohio
Title of Paper: "COLD HEADING WIRE"

1935 — R. A. SCHATZEL
Superintendent, General Research Laboratories, General Cable Corp., Rome, N. Y.
Title of Paper: "HARD AND SOFT COPPER WIRE"

1936 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "PLASTIC DEFORMATION IN WIRE DRAWING"

1937 — ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Co., Atlanta, Ga.
Title of Paper:
"A METALLURGICAL STUDY OF THE FACTORS AFFECTING THE QUALITY OF GALVANIZING"

1937 — ALLAN B. DOVE
Chemical Engineer, Canada Works, The Steel Company of Canada, Ltd., Hamilton, Ont., Canada
Title of Paper:
"A. C. ELECTRO PICKLING—A BETTER METHOD OF PICKLING"

1938 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Spencer Steel Co. Worcester, Massachusetts
Title of Paper: "RESILIENCE OF SPRINGS"

1939 — JOSEPH A. DOYLE
Vice President, W. S. Rockwell Co., New York, N. Y.
Title of Paper: "HEATING COPPER WIRE BARS"

1940 — H. BLOUNT and J. D. WILTRAKIS
Mfg. Engineer, Point Breeze Works, Engineer, Kearny Works, Western Electric Company
Title of Paper:
"DESIGN AND OPERATION OF A NEW COPPER WIRE DRAWING PLANT"

1941 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Wickwire Spencer Steel Co., Worcester, Massachusetts
Title of Paper:
"TIME, TEMPERATURE AND SIZE IN THE HEATING OF STEEL WIRE"

1942 — COLONEL FRANK W. BULLOCK
Signal Corps, United States Army
Title of Paper: "THE WIRE INDUSTRY IN WAR"

1943 — E. J. CRUM
General Foreman, Bethanizing and Galvanizing Departments, Bethlehem Steel Company, Sparrows Point, Md.
Title of Paper:
"THE GRAPHICAL SOLUTION OF WIRE MILL MATHEMATICAL PROBLEMS"

1944 — FERNALD S. STICKNEY
Vice President and Chief Engineer, Instrument Specialties Company, Little Falls, N. Y.
Title of Paper: "MAKING 'SPRING-GRADE' BERYLLIUM COPPER WIRE"

1945 — RALPH C. ELLAMS
Supervisor, Electrical Coating Development
Roxalin Flexible Finishes, Inc., Elizabeth, N. J.
Title of Paper:
"SUCCESSFUL FINISHING OF ELECTRICALLY INSULATED WIRE AND CABLE"

1945 — D. A. SUTCH, Metallurgist,
and B. L. McCARTHY, Chief Metallurgist,
Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper:
"REDUCTION OF AREA VALUES AS A GUIDE TO PATENTING"

HONORABLE MENTIONS
1946 — NO AWARDS

INDUSTRIAL DIAMOND ASSOCIATION
OF AMERICA, INC.

STEPHEN W. HOFFMAN, President CHARLES J. KOEBEL, 1st. Vice-President WALTER J. MEINHARDT, 2nd Vice-President

Communications:
ATHOS D. LEVERIDGE
EXECUTIVE MANAGER
& Secretary-Treasurer
501 LEXINGTON AVENUE
NEW YORK 17, N. Y.
WICKERSHAM 2-1400

For Good Productivity In Diamond Dies

An Open Letter to the Wire Manufacturing Companies

By Athos D. Leveridge, Executive Manager

The second in a series of letters addressed to the Wire Drawing Industry. The next letter in this series will be concerned principally with the positive methods for determining the value of diamond dies.

IN the Association's previous open letter, stress was laid on the importance of good quality, and on a fear that diemakers might not be able to maintain it in view of inflationary conditions. And this, after a successful period of effort at improvement of product and merchandise. It was also indicated that the diamond die, in spite of its outstanding role in the production of wire, represented such a very small percentage of wire production costs, that everything possible should be done to help the diemakers maintain their standards.

* * *

A natural question from the wire manufacturer might be, "What is **your** idea of a good diamond die?" To answer this, we would first refer to three elements which are inherent in a good die: First, the **Diamond** itself.

* * *

AS there are diamonds of all types in color, shape, purity and size, a selection of one with the properties which indicate it to be of the proper type for the die required is of first importance, — which includes consideration of ample size and proper shape for the job. When all these factors are inherent in the diamond used, a wire plant's repair department will obtain the maximum number of recuts. But the greater wire poundage thus obtained would not be possible if little or no care were given, even in an efficient die plant, to this first consideration: selection of the right diamond for the die that is to be made.

THE American industry's concentration upon top quality diamonds springs from requirements of our modern, high speed era. The European dies in use before such improved wire production, were made with inferior, less expensive and flatter types of diamonds, because such stones could stand up under slower speeds. Today's wire manufacturer, now accustomed to our higher quality diamonds, will not wish to turn back, having enjoyed the great poundage resulting from the long life of today's American die; also, a small diamond cannot recut to the large diameter possible in a larger diamond of the same quality.

* * *

THE second important factor is **Setting** (or mounting). A diamond whose bearing is constantly under great strain as ferrous or nonferrous alloys are drawn through it, and which is subject to friction even when properly lubricated, requires the best support and reinforcement obtainable. Although this has reached a high degree of perfection, die manufacturers are continually experimenting with the aim of further improving their setting.

* * *

WORKMANSHIP is the third important factor. While quality and proper type and size of diamond with expert setting must all be present in the perfect diamond die, the factors of proper diamond and proper setting must be supplemented by fine workmanship, if a perfect diamond die is to result. This Association's paper on the use and care of diamond dies contains references to the good workmanship of today, and these are aided by illustrations of ideal contours in die profiles.

* * *

IT is felt by the I.D.A. that if the wire companies will consider all that must be put into a good die:— quality diamonds, quality materials, skillful labor and careful supervision, they would not apply, with a view to economy, the same methods in their die purchasing as they do for mass produced items. When a hand-made item of precision such as the diamond die must be produced under the pressure of competing with inferior dies, **economy does not result.**

* * *

THE paper above referred to, entitled "Use and Care of Diamond Wire Drawing Dies" was based on data from the diemakers of the Industrial Diamond Association which sponsored its publication in the American Society of Mechanical Engineers' "Metal Cutting Data". The article also provides a mature discussion of modern die room methods by which diamond dies can be assisted in giving best performance. A copy will be sent you with the compliments of I.D.A. and its die manufacturing members upon your request addressed to me at 501 Lexington Ave., New York 17, New York.

REELS of WOOD

RETURNABLE
and
NON-RETURNABLE

Furnished assembled or knocked down, made to your specifications. Will withstand severest handling. Sturdy, strong, low in cost. Made for

CABLE,
ROPE and
WIRE

Made in any size, from
12" to 96" in diameter.

ALSO, REEL HEADS FOR STEEL DRUMS

Send us your specifications and let us quote on costs.

BRIDGE MFG. CO., Inc.

HAZARDVILLE CONN.

Foreign Notes

THE money reformation in Germany has brought in the open many hoarded stocks. Wire nails, as well as other wire products are now in sufficient quantities, but there are no buyers. Prices have advanced by 70 to 90% since May, and there is so little money among the consumers, that virtually nobody is able to buy. The result is that the old system of barter trading has again been introduced. Farmers, for instance, barter berries (strawberries, gooseberries) and mushrooms, for which this rainy year was particularly good, against barbed wire, fencing wire, etc. The manufacturers use the fruit, etc., obtained for part payment to their workmen, since they have not sufficient cash to pay the salaries and wages. Multifold similar systems have developed to create "additional currency".

* * *

THE export business has been very badly affected, since more than half of all export contracts, (in some districts even more), have been cancelled and new orders are almost nil. The reason has been explained in this column before. The production costs are much too high. At the moment it is necessary to employ approximately 120% more workmen in Germany to produce one ton of wire nails, than in the U. S. A. Before the war, 8%. This not only results in poor food, but particularly in these circumstances, where the machinery and equipment is hopelessly obsolete, with no possibility of getting new replacements, it makes for handwork (manufacture). War damages force the employer to use handwork many times, where machinery is lacking.

* * *

A third reason is, that while a traveler can change his Dollar at the bank for 10 DM, the exporter gets from the Joint Export and Import Agency only 3.30 marks for each dollar, and this great discrimination leaves the exporters hopelessly behind.

* * *

SINCE the middle of July, almost all manufacturers have declined to accept more export orders. The

dismissal of workmen has been only slight so far, as large domestic orders had been pending, but new business from the domestic market has also fallen off almost completely.

* * *

THE German wire export trade for the first half of this year was only 4.3% in value of what it had been in 1938 for the same time. The Austrian 18.6%, the Czecoslowachian 73.8% and the Polish 107%. Poland is sending most of its products to Russia.

* * *

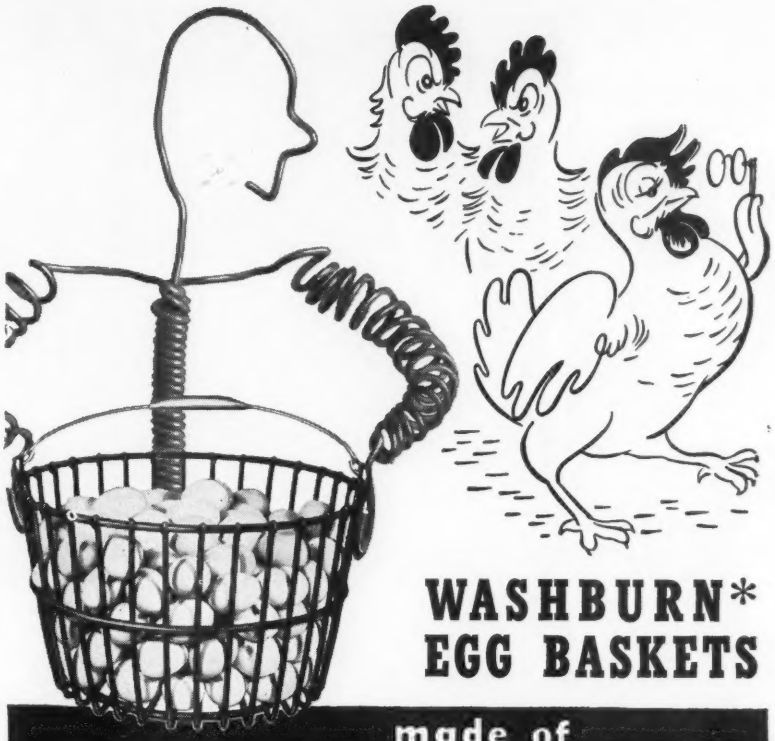
THE rise of production of wire and wire products in France, propagated by the Monnet-plan has been realized with 88% of the scheduled figure. The production plan foresees for this year an output of 412,000 tons of wire rods and 403,000 tons of wire and wire products. This is about 50% more than 1946. The supply of wire products to the domestic market is now sufficient. To the "Free" markets only 3% of the output has been sold in this year. The total percentage of export is 11% of the production, the bulk going to the Colonies.

* * *

THE German steel industry complains that scrap is too scarce. Import of iron ores has also not yet restarted and the German deposits are insufficient. The JEIA exported the first half of the year 1,218,000 tons; 540,000 tons to Great Britain and 440,000 tons to the U. S. A. whereas the German steel works' quantities represented only 85% of the necessary consumption. The lack of scrap is the main reason why the steel production cannot hope to reach the figure granted to Germany at Potsdam (5.8 million tons of steel annually) and of course the present established figure of 11 millions is quite out of the question. The output will fall short of 4 millions this year.

* * *

THE German needle industry in the Aachen district operates at 40% of the present capacity which is 55% of prewar. The output was 55 million pieces last year and will be approximately 70 this year. It is hoped to be able to sell 25% for export (at present 20%). Instead of 2,000 different types as in 1938, only 750 are produced at present.



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Rubber-Coated Farm Basket for potato harvesting and general crop handling

The Washburn Company Rockford, Illinois

Rubber coated egg baskets manufactured by the Washburn Company minimize egg breakage . . . cool eggs quicker . . . reduce handling costs . . . and help poultrymen get premium prices.

These especially designed baskets are constructed of dependable, uniform Keystone wire that has proper ductility for easy forming . . . a clean, bright surface for spot welding and rubber adhesion.

The efficiency of Washburn Rubber Coated Baskets is matched by sturdy construction . . . important reasons why Keystone wire is the choice of the manufacturer.

Whatever your wire need . . . Keystone can normally supply it.

SPECIAL ANALYSIS WIRE for all industrial purposes

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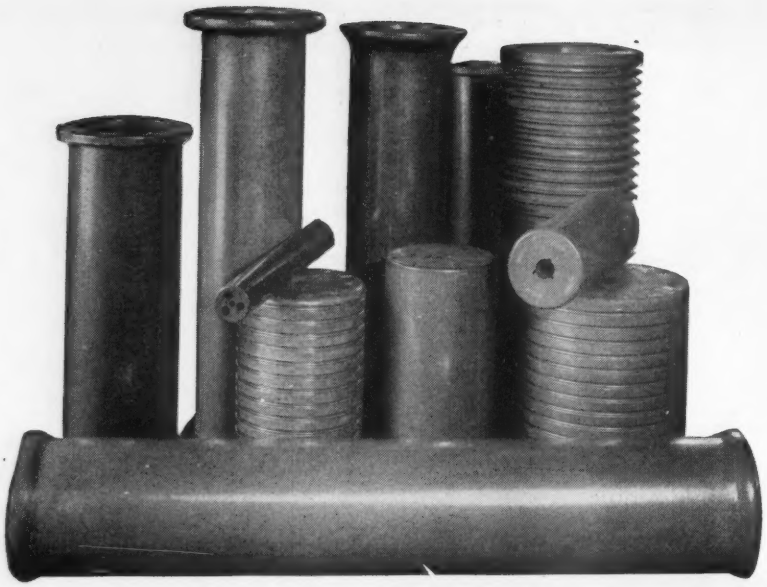


Corrosion-Proof Rolls and Processing Tanks

Knight-Ware corrosion-proof wire and sheet rolls or sinkers are made to meet customers' needs. You can choose the diameter, groove spacing and length to fit your operation. They are entirely acid-proof and hard with no coating or shell to depend on for acid resistance or wear.

Pickling and plating tanks which are acid-, alkali- and leak-proof are available of Pyroflex Construction. These are steel tanks lined with suitable corrosion-proof materials to best meet your particular operating conditions.

Knight engineers welcome your inquiries on wire rolls and Pyroflex processing tanks. Be sure to give them as complete data as possible regarding the character and purpose for which this equipment is to be used.

MAURICE A. KNIGHT
Kelly Avenue, Akron 9, Ohio

Typical Knight Pickling Tank of Pyroflex Construction

Titanium

THE **Du Pont Company** recently announced that it had begun the small-scale manufacture of titanium metal, a new basic raw material for industrial development.

* * *

A pilot unit of 100 pounds daily capacity has been successfully placed in operation at the Newport, Del., plant of the Pigments Department. This, so far as the company knows, is the first time ductile titanium metal has been produced for commercial exploration. The U. S. Bureau of Mines has been producing the metal for research purposes.

* * *

THE silver-white metal is light and strong. It is highly resistant to corrosion and has a higher melting point than the commonly used metals. It is comparable to stainless steel in strength and corrosion resistance, but weighs only a little more than half as much per unit of volume. It is less than twice as heavy as aluminum, but several times as strong, in bars of comparable dimensions.

* * *

DU Pont is producing and offering it for exploration as a basic raw material for industry and engineering. It has many interesting properties, but exhaustive research will be needed to develop the full possibilities of titanium metal. When this work is done and if titanium alloys work out as expected, scientists believe they may have a new family of structural materials far superior in many ways to any metals or alloys now known.

* * *

TITANIUM metal is so new as an industrial material that little is now known about what it will do. Enough is known, however, to indicate that it can be used where a high ratio of strength to weight is needed. Reports of the Bureau of Mines and other organizations indicate that an early major use may be in high-speed planes and other forms of transportation. It may go into corrosion-resistant equipment and industrial machinery such as printing presses and textile equipment.

* * *

THESE reports also indicate that the properties of titanium are such that it may be used for reciprocating mechanical parts and in jet engines where heat and pressure are great.

* * *

FURTHER research on the metal is now being carried on by other organizations, not only to determine its uses but also to determine its alloying possibilities. Meanwhile, Du Pont technologists are in the midst of preliminary design work to expand production and improve the present manufacturing process.

* * *

TITANIUM is plentiful in nature. It is the seventh most common metal, and the ninth most common element in the earth's crust, and is more than a hundred times as plentiful as copper, zinc, or lead. Titanium metal is very difficult to separate in pure form from its ores. This fact has kept it practically a laboratory curiosity since its discovery as a chemical element back in Revolutionary War days. There are enough workable deposits of rutile and ilmenite, the ores from which it comes, in the United States and Canada that America may become independent of overseas sources.

* * *

DU Pont has long used large quantities of the ore to obtain titanium in oxide form for paint pigments. Research leading to its production in metallic form grew out of this experience, and manufacture of the metal is being handled by the Pigments Department. The process is basically a chemical one.

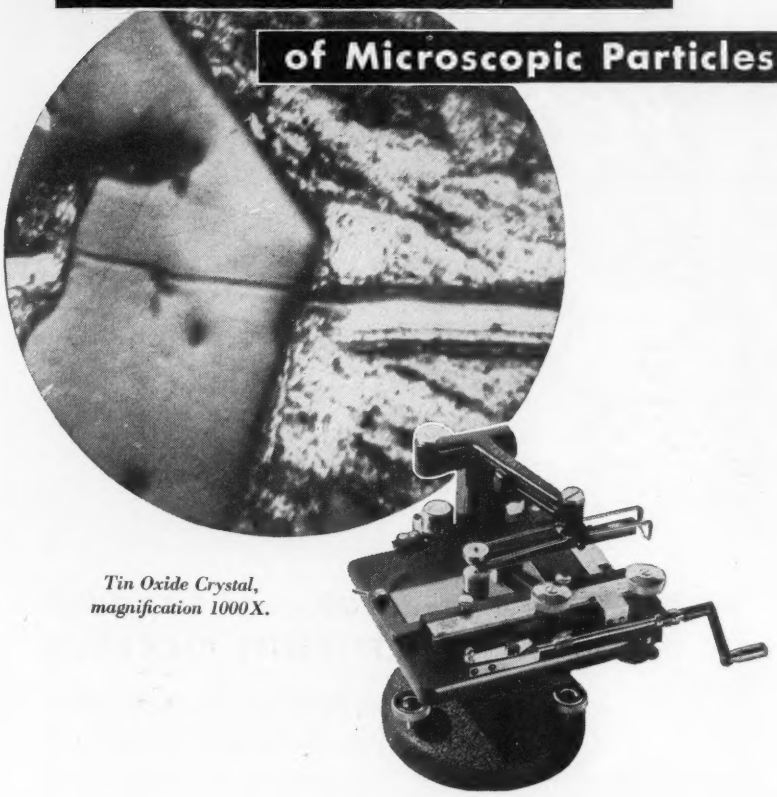
* * *

DU Pont became active in basic research on the metal before World War II but stopped during the war. The Bureau of Mines continued its efforts and had developed a successful method of refining it by the end of the war. After the war, Du Pont resumed its research which resulted in the successful production.

* * *

MOST titanium metal which has been available heretofore has been in powder form. Du Pont is producing it now in sponge form and will shortly be producing ingots

A PRECISE HARDNESS TEST
of Microscopic Particles



Tin Oxide Crystal, magnification 1000X.

WITH a Spencer Bierbaum Microcharacter you can measure accurately the hardness of small areas, particles, and microscopic constituents of metals.

The specimen, highly polished and lubricated, is moved by micrometer feed beneath an accurately ground diamond point. The point is cube shaped for durability and ease of duplication. Pressure is precisely controlled so that hardness can be determined under the microscope by measuring the width of the resulting cut.

The Microcharacter is recommended for use with Spencer Metallurgical Microscopes. For further information write Dept. M160.

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"Yes" TO
NEP*
NEPTUNE*
AND
Sum-Foam*

INHIBITORS, ACCELERATORS and FOAMING COMPOUNDS FOR EFFICIENT PICKLING

Steel men are particular people. They do not approve easily. BUT—when it comes to Parkin products for pickling steel; the answer is invariably an unqualified YES!

HERE'S WHY { PARKIN ACID INHIBITORS, ACID ACCELERATORS AND FOAMERS are the most efficient available: EACH THE RESULT OF YEARS OF SPECIALIZED EFFORT TO MAKE THEM SO.

There is an important place in your pickling operations for our products. Prompt information, advice or service of any kind is yours for the asking.

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Parkin Pittsburgh
IN STEEL SINCE 1860

weighing up to 100 pounds. Running 99.5 per cent plus of purity, the metal is ductile and can be rolled and drawn readily. It has high resistance to breaking or pulling and has high strength against distortion.

* * *

PRESENT price of the Du Pont product is $5 per pound for quantities of 100 pounds or more in sponge form. Ingot prices will be set later. The company will supply small samples without charge to industrial and university laboratories for testing. As the process is improved and if demand warrants mass production of the new metal, the company hopes to be able to reduce the price sharply.

Steam Homo Tempering

SCALE-FREE tempering and strain relief of metal parts is now being performed to an increasing extent by the Steam Homo Method, recently developed by **Leeds & Northrup Company.** High-speed steel tools, cast iron, sintered powdered iron compacts and non-ferrous alloys are being treated by this method at temperatures up to 1150 F.

* * *

BY adding a protective steam atmosphere to the well-known Homo forced-convection heating and its Micromax temperature control, the method, reports indicate, is enabling heat-treaters to turn out steel parts with a uniform blue oxide finish. Parts are free from scale, have improved machinability, increased resistance to corrosion and wear, and are easier to clean for subsequent plating. High-speed tools, for example, exhibit improved life when cutting hard or abrasive materials. Powdered iron parts, after steam treating, have greater density and hardness.

* * *

STEAM from a process line or a small boiler is fed into the work chamber through an inlet in the bottom of the furnace. Although especially designed for steam tempering, the furnace can also be run with natural air atmosphere, like any conventional Homo Tempering Furnace.

Outstanding Personalities of the Wire Industry

Firth Sterling Steel and Carbide Corporation Personnel Changes

REORGANIZATION of operating personnel and a change in sales and manufacturing policy in the Carbide Division was announced today by **J. W. Kinnear Jr.**, executive vice president of **Firth Sterling Steel & Carbide Corporation.**

* * *

MAJOR personnel changes in the new organization plan include the appointments of **W. J. Loach** as manager of Carbide Development and Quality Control; **Charles W. Iams Jr.**, manager of Carbide Production and Fabrication at the McKeesport Plant; **E. G. Moffat**, works manager of the corporation's recently completed plant at Milford, Conn., and **A. B. Vestal**, superintendent of Plant Engineering at McKeesport.

L. G. Firth, in addition to his duties as president of the corporation, is accepting the office of Director of Technical Development.

* * *

BECAUSE of the expansion in the specialized carbide tool and die making industry in recent years, the company's new sales and manufacturing policy will be to concentrate on the manufacture of sintered carbide metals in all forms and standard single point tools and dies. However, the fabrication of other carbide tools and dies will be continued where carbide is in the development stage or no adequate commercial tool and die making facilities are available.

* * *

THESE changes will enable Firth Sterling to place greater emphasis on research and development to expand the uses of sintered carbide metals.

FIRTH Sterling is a pioneer in the development of sintered carbide metals which were responsible for remarkable production records in the manufacture of war material during World War II. The company also manufactures tool and alloy steels and the new policy does not affect this part of the business.

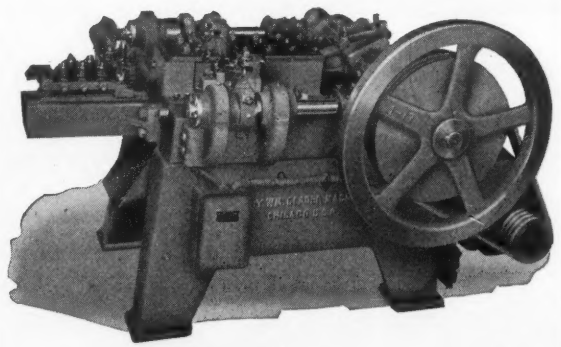
* * *

MR. Loach formerly was superintendent of Carbide Production at McKeesport; Mr. Iams has been assistant to the executive vice president, and Mr. Moffat was manager of the Tool and Die Department.

A. S. & W. Appointments

WALTER E. Mackley has been appointed manager of the New York district sales office of **American Steel and Wire Company,**

GLADER HIGH SPEED WIRE NAIL MACHINE



MACHINE ARRANGED FOR INDIVIDUAL MOTOR DRIVE

High tonnage output, and low maintenance costs, have resulted in Glader Machines being accepted as standard equipment in every large nail mill built in the United States in the past twenty years.

Glader Machines are operating in most of the wire producing mills throughout the world.

These machines are made in eleven different types and sizes. This enables us to cover the range of sizes of nails produced with the greatest efficiency.

For further information please address,

WM. GLADER MACHINE WORKS

210 No. Racine Ave.
Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

United States Steel subsidiary. **F. L. Nonnenmacher** has been named manager of manufacturers' products sales to succeed Mr. Mackley, while **Harold Christopher** has been promoted to the position of assistant manager of that department.

* * *

MR. Mackley succeeds **B. W. Bennett**, who has been named assistant to the vice president — sales of the American Steel & Wire Company. In his new capacity, Mr. Bennett will continue to maintain his office in New York, and will handle special assignments.

Dr. F. R. Morral at Syracuse University

DR. **F. R. Morral**, well-known in wire circles through his active participation in Wire Association affairs and his frequent articles in Wire and Wire Products, has accepted an invitation to occupy the chair of Associate Professor of Materials Engineering at Syracuse University. He will teach metallurgy and engage in research and consulting work.

* * *

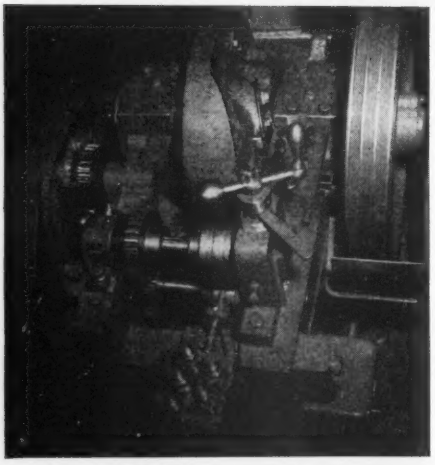
DR. Morral has been an active member of the Wire Association for some years. In 1947 he was chairman of the Technical Program for the Chicago Convention. A series of his papers on coatings, electroplating, history, salt baths, employee selection in the metallurgical industry, and several others have appeared in Wire and Wire Products. He is a member of various metallurgical and related societies in this country and England. Professor Morral was Group Leader of the Metal Trades Laboratory of the Technical Service and Development Division of the Stamford Research Laboratories of the American Cyanamid Company. Previously he was associated with the Mellon Institute, was Assistant Professor of Metallurgy at Pennsylvania State College, and Research Metallurgist with Continental Steel Company of Kokomo, Indiana. He has taught metallurgy at night school and also conducted defense training courses at Kokomo, Muncie, and Marion, Indiana.

Dr. F. R. Morral, Associate Professor of Materials Engineering at Syracuse University * *

* * *

DR. Morral obtained his scientific and technical education in this country, Sweden and Spain. His

1000 STAPLES PER MINUTE!!!



Top View, showing Fly Wheel and Gears

FENCE STAPLES — POULTRY NETTING STAPLES — DOUBLE POINTED TACKS (WIRE CLOTH TACKS)

Fastest Staple Cutter Ever Made — Makes Two Complete Staples at each revolution — Compact, Easily Adjustable, Efficient.

48 Different Leg Lengths, Gauges 9 through 18

Can Be Made With

HUMPHREY RAPID STAPLE CUTTER

Early Deliveries of Belt or Motor Drive Machines Now Possible. Send for complete details and prices.

Manufactured Exclusively For

REED and RICHARDS TRANSATLANTIC, INC.

CHANIN BLDG., 122 EAST 42nd ST., NEW YORK 17, N. Y., U.S.A.

REG. CABLE ADD.. "LOUREED, NEW YORK".

Also Bale Tie Machines, producing single loop, round or oval ties, 2000 per hour; 3 to 16 ft.

Ph. D. degree in Metallurgy was granted by Purdue University, the B. S. in Electrochemical Engineering by Massachusetts Institute of Technology.

* * *

IN Spain, he was co-founder of a metallurgical society, and founder, business manager and assistant editor of a monthly metallurgical magazine. At the same time he was manager of a wool spinning mill and active in research and development at the metallurgical and electrochemical laboratories of the University of Barcelona. He has been continuously in this country since 1936.

* * *

Fiberglas Advertising Manager Appointed

STEPHEN J. Daly, formerly Special Assistant to the Director of Advertising, E. I. duPont de Nemours & Company, Inc., Wilmington, Delaware, has been named Advertising Manager of **Owens-Corning Fiberglas Corporation**, Toledo, Ohio.

* * *

MR. Daly has been associated with the Advertising Department of the duPont Company since 1935. He has been associated with the duPont magazine, the "Cavalcade of America" radio program, and for several years was a Divisional Advertising Manager handling the advertising of such products as pigments, ammonia, and neoprene synthetic rubber. During the past year he was President of Eastern Industrial Advertisers, the Philadelphia Chapter of the National Industrial Advertisers Association.

* * *

AS Advertising Manager of Owens-Corning Fiberglas Corporation Mr. Daly will manage the company's advertising activities under the direction of **E. C. Ames**, Director of Advertising.

Carnegie Institute of Technology Appointments

TWO outstanding young nuclear scientists, **Truman P. Kohman** and **Robert G. Parr**, both of Washington, D. C., have joined the Department of Chemistry of the **Carnegie Institute of Technology**, President Robert E. Doherty announced recently.

* * *

BOTH men will hold the rank of assistant professor. Dr. Kohman will teach nuclear chemistry; Dr. Parr, theoretical chemistry.

* * *

DR. Kohman received his bachelor of arts degree, cum laude, from Harvard in 1938. The University of Wisconsin awarded him a doctor of philosophy degree in 1943.

* * *

FORMERLY a group leader at the University of Chicago for the Manhattan project, Dr. Kohman also served as a chemist at the Hanford, Washington, atomic center.

Hydraulically Operated

TRAVERSE REELS

FOR FLAT WIRE AND NARROW STRIP

- The self-contained, compact SECO Traverse Reel has smooth, powerful hydraulic operation — at speeds from 150 to 600 feet per minute.

PERFECT SPEED CONTROL from zero to top running speed through flow control.

ACCURATE TENSION CONTROL through pressure regulation.

Built in sizes for coils weighing up to 600 lbs., for round or flat wire. Unit shown occupies floor space 24" x 42". Modifications in design and construction to meet specific requirements.

WIRE SPOOLERS

Single and Multiple Type

Speeds Up To 4,000 feet per minute

STEEL EQUIPMENT CO.

SECO 2890 EAST 83rd STREET CLEVELAND 9, OHIO

THE new appointee will join Tech from the Institute of Nuclear Studies, University of Chicago, where he has served since 1946 as a Fellow and lecturer.

* * *

DR. Parr, an expert on molecular structure and high temperature thermo-dynamics, graduated from Brown University in 1942 with a bachelor of arts degree. In 1947 he was awarded the degree of doctor of philosophy from the University of Minnesota.

* * *

DURING World War II, Dr. Parr served with the office of Scientific Research and Development studying explosives and propellant burning. While at Tech he will retain his position as consultant to the Navy Bureau of Ordnance.

Nopco Adds to Staff

APPOINTMENT of **Walter E. Brewer** as district sales manager for its newly formed Eastern District has just been announced by **T. A. Printon**, Vice-President, Industrial Division, **Nopco Chemical Company**, Harrison, N. J.

* * *

MR. Brewer will head up the present field force of five representatives and will be responsible for sales on the products of Metasap Chemical Company as well as those of the Industrial Division of the parent company. He is well qualified to handle his new assignment which is effective immediately. A graduate of Muhlenberg College with a B. S. degree in chemistry. Mr. Brewer has been with Nopco over 12 years. Before acting as a sales representative in Eastern Pennsylvania, a post he has held for the past three years, he acted in the same capacity in the New England area. He is well versed in company products and their application having spent several years in the Harrison laboratories working on product control and customer service problems.

* * *

THE new Eastern District comprises the Middle Atlantic States from Metropolitan New York to Virginia. In setting it up, Nopco is following a plan inaugurated four years ago to integrate its industrial sales activities within certain geographical areas. This plan has enabled the company to offer greater customer service and obtain wider market coverage on its extensive line of processing specialties.

* * *

A. C. Wheeler Elected To Presidency Of The Seymour Mfg. Co.

AT a recent meeting of the board of directors of **The Seymour Manufacturing Company,** Arthur C. Wheeler was elected president.

* * *

THE following officers were also elected: President, Arthur C. Wheeler; executive vice president, Alton G. Wentworth; vice president, Bernard H. Matthies; vice president, Earl B. Boise; secretary and treasurer, Harry A. Leigh; assistant treasurer, Charles Wohlfarth and assistant secretary, Robert W. Brown.

* * *

AUTOMATIC
STRAIGHTENING AND CUTTING
MACHINERY
Equipped with
FLYING SHEAR
for
ALL KINDS OF MATERIAL
THE HALLDEN MACHINE CO.
THOMASTON, CONNECTICUT

Yale & Towne Appoints O. G. Schwenk

OTTO G. Schwenk of Shaker Heights, Ohio, has been appointed vice president in charge of production of **The Yale & Towne Manufacturing Company** and assumed his duties as of September 1st, it was announced recently by Calvert Carey, president.

* * *

BEFORE joining Yale & Towne, Mr. Schwenk was serving as assistant to the president of The Weatherhead Company of Cleveland. He obtained his manufacturing experience by working successively as a laborer, foreman, industrial engineer, general production manager and finally assistant to the president in several eastern and middle western companies before affiliating with The Weatherhead Company.

* * *

A. S. & W. New Sales Division For Electric Wire

CREATION of a new and separate sales division to handle the electrical wire and cable products of **American Steel & Wire Co.** was announced recently.

* * *

ESTABLISHMENT of the new division with four regional sales offices throughout the country will permit concentration of sales effort on such items as the paper insulated cable, rubber jacketed cable, galvanized telephone wire, and Amerductor, the transmission cable used for rural electrification lines.

* * *

T. **R. Peterson,** who has headed the section of the general sales staff of the company devoted to electrical products, will serve as manager of sales of the new division. His offices will be in the Union Commerce Building.

* * *

C. **H. Eisenhardt,** formerly assistant manager of sales in the section, will serve as assistant manager of sales in the new division.

* * *

FOUR new district sales offices under the new organizations will be established in Boston to serve the New England district, in Cleveland to serve the Central district, in Chicago to serve the Western district, and in New York to serve the Eastern district.

* * *

APPOINTEES to the positions of managers of these various offices are as follows: **C. H. Currier,** manager, New England district, electrical products sales; **V. W. Heimberger,** Central district; **R. A. Coates,** Western district; **C. M. Vaill,** Eastern district.

Best to Have Charge of Finances of W.E.

GEORGE L. **Best,** vice president in charge of patent licensing activities of the **Western Electric**

ADVERTISE IN THE BUYERS GUIDE in 1949

The buying reference book for our Industry

This directory, THE WIRE AND WIRE PRODUCTS BUYERS GUIDE AND YEAR BOOK OF THE WIRE ASSOCIATION, is a complete guide for buyers of all kinds of wire, rod, machinery equipment and supplies made in the United States for and by the Wire Industry.

It is an invaluable source of information on everything of interest to wire men and contains over 26,000 listings, classified by subjects. Because it is widely used as a reference on sources of supply, you should by all means advertise in it. It pays to use the BUYERS GUIDE.

The next edition will be published in April, 1949, for which forms close on January 25. It supplements and fortifies your advertising in WIRE AND WIRE PRODUCTS.

Rates and information furnished on request.

WIRE AND WIRE PRODUCTS

300 MAIN STREET STAMFORD, CONN.

Company, manufacturing and supply unit of the Bell System, has been named vice president-finance to succeed **T. Kennedy Stevenson**, it was announced by Stanley Bracken, president. Mr. Stevenson, vice president-finance since 1941, will retire on November 30 under the Company's age retirement rule and Mr. Best's appointment will become effective at that time. Mr. Best will continue to be responsible for patent licensing in addition to duties associated with his new post.

Extreme-Pressure Lubricant

MOLYKOTE, a new-type dry lubricant, consists essentially of molybdenum disulfide powder and has the appearance of graphite, though it contains none. With light rubbing it adheres tenaciously to even the smoothest surfaces and this property is a basis for its superiority. Numerous tests have shown its extremely low friction coefficient and phenomenal capacity to prevent galling, seizing, or metal-to-metal contact at pressures well over 100,000 lbs. psi at either high or low sliding velocities and is not affected through a wide range of temperature variation.

* * *

TEN ounces will cover 500 sq. ft. of smooth metal surface with a tenacious, shiny coating. This tenacity suggests its use as a **factory-applied lifetime lubricant** for mechanical devices. When used on screw fasteners or press fits, assembly takes place at a smoothly increasing torque or force without jerking, indicating theoretically perfect lubrication. Experiments in deep drawing and wire drawing indicate that it may have some possibilities in those directions. Molykote is available in 10-oz. shaker-type cans at $3.00 per can FOB Greenwich from **The Alpha Corp.**, Greenwich, Conn.

Emil R. Gasser
Farrel-Birmingham Research Director

AT 44 years of age, death came suddenly to **Emil R. Gasser**, director of research of **Farrel-Birmingham Company, Inc.**, September 5, at his home in Buffalo, New York.

* * *

MR. Gasser was first employed by Farrel-Birmingham in 1928 and, for the past three years, directed the activities of the physics laboratory at the company's Buffalo, New York plant. For his work in development of propulsion gearing and related design during World War II, Mr. Gasser was awarded a citation by the Navy Department.

* * *

MR. Gasser was born and reared in Switzerland, and his death occurred only a week after his return from an extended visit to that country. He was educated in schools in Schaffhausen and Zurich and he first came to the United States in 1925, locating in Buffalo.

* * *

HE was a member of the Society of Automotive Engineers, the American Society of Naval Engineers, the Society of Naval Archi-

MANUFACTURERS OF TUNGSTEN CARBIDE PRODUCTS

SINCE 1926

SUPPLIERS OF EVERYTHING IN TUNGSTEN CARBIDES

Specialists in Drawing Dies for Wire, Rod and Tubing, Also Heading and Extrusion Dies.

Complete Facilities for Fast Economical Precision Production.

Distributors:

EDGECOMB STEEL CORPORATION
HILLSIDE, N. J.

MASTER WIRE DIE CORP.
Atlas Terminal
GLENDALE, L. I., N. Y.

tects & Marine Engineers, the American Gear Manufacturers Association and served on a special research committee of the Navy since the end of the war.

Butts to Head Sales for Auto-Lite

H. R. Butts has been appointed General Sales Manager, Wire Division, of **The Electric Auto-Lite Company,** according to an announcement made recently by **Royce G. Martin,** President.

* * *

MR. Butts, who entered the Auto-Lite sales staff 14 years ago, replaces **Verne F. Dobbins,** who has retired for reasons of health. Joining Auto-Lite in 1934 in the sales department of the Wire Division, Mr. Butts has served as Central Division Manager of the Merchandising Division, and for the past 10 years has held a similar post in the Southern Division with headquarters in Dallas, Texas. He will make his new headquarters in Port Huron, Michigan.

Firth-Sterling Appoints Richards as General Sales Manager

GILBERT B. Richards has been appointed general sales manager of **Firth Sterling Steel & Carbide Corporation** with headquarters at McKeesport, Pennsylvania, to coordinate the sales of the steel, carbide and tool-making divisions of the company. Mr. Richards was formerly general sales manager of Bostitch, Inc., Westerly, Rhode Island, and previously commercial sales manager for Firestone Tire & Rubber Company.

Gilbert B. Richards, General Sales Manager, Firth Sterling Steel & Carbide Corporation.

Westinghouse Electric Company Appointment

RALPH R. Brady has been appointed manager, engineering department, Lamp Division, Bloomfield, N. J., for **Westinghouse Electric Corp.** He succeeds the late **D. W. Atwater.**

* * *

APPOINTMENT was also announced of three district electrical sales engineers to serve in the new electrical products division. They are as follows: **Curtis E. Plass,** Western district, Chicago; **Walton P.**

The SPECIALISTS in Wire-Straightening and Wire-Cutting!

Diameter Range — 1/16" to .005"

PRECISION - Our Motto

DON'T hesitate to call on us when you are confronted with wire-straightening problems involving close tolerances and absolute accuracy. For seventeen years we have specialized in straightening and cutting all gauges of fine wire, hard or soft, ranging in diameter from one-sixteenth of an inch down to five-thousandths of an inch. We employ gun-barrel accuracy in straightening lengths from one inch to ten feet or any fractional part thereof. Ends cut absolutely clean without burrs.

ASK ABOUT OUR UNEXCELLED FACILITIES FOR CLEANING AND POINTING WIRE ALREADY STRAIGHTENED AND CUT.

ALL TYPES OF WIRE...

- Nickel
- Stainless Steel
- Bronze
- Brass
- Copper
- Alloy Wire
- Music Wire
- Tag Wire
- Florist Wire

Write us today!

Manufacturers of the famous ARMA PAPER CLIP

PITTSBURGH CUT WIRE COMPANY

1112-20 GALVESTON AVENUE · PITTSBURGH, PENNSYLVANIA.

TELEPHONE: CEdar 4702

Lewis, Central district with headquarters in Pittsburgh; and **Harry E. Purdy,** Eastern district, New York.

* * *

Carl A. Carlson

CARL. A. Carlson, sales engineer for **Norton Company,** Worcester, Massachusetts, died Sunday, August 29, in a plane crash near Winona, Minnesota.

* * *

BORN in Stockholm, Sweden, June 19, 1888, Mr. Carlson graduated from the Sala Engineering School in Sweden. He came to the United States in 1912 and began his long career with Norton Company July 9, 1913.

* * *

MR. Carlson's outstanding contributions to Norton Company and to the metal working industry in this country have been almost limitless.

* * *

HE was the inventor of a billet grinding machine (1943) and a wire grinding machine (1944) — both patented.

* * *

HIS influence was a vital factor in the establishment of high speed grinding and directed his company's activities in a successful program to develop resinoid bonds for high speed grinding in foundries and steel mills throughout the United States.

* * *

MR. Carlson was a leading consultant on snagging operations and was considered one of the best informed men in this field in the world.

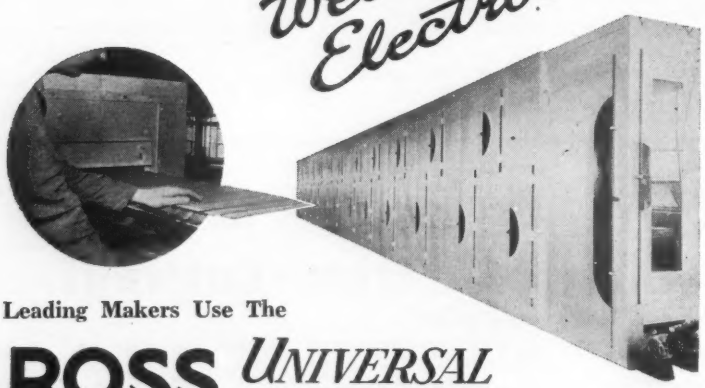
* * *

HE was the author of many technical articles on abrasive grinding wheels — his latest, entitled "Foundry Grinding Wheels, Manufacture and Use", appeared a year ago in "American Foundryman". In addition, he contributed periodically to "Grits and Grinds", Norton Company's monthly technical publication.

When you write an advertiser for prices or information, PLEASE MENTION the fact that you saw his ad in WIRE AND WIRE PRODUCTS. It identifies your inquiry and expedites service.

TO PRODUCE BETTER

Welding Electrodes



Leading Makers Use The

ROSS *UNIVERSAL*

Welding Rod Ovens

Because they are designed to maintain highly uniform control of air temperature and circulation these modern ROSS OVENS can be depended upon to produce the desired hard, dry coating that characterizes the better makes of electrodes. ROSS OVENS, like the 5-pass chain conveyor type illustrated, provide baking temperatures of from 125° to 450° F., depending upon the type of electrode being processed, and possess many exclusive operating features. Write for full particulars.

PROMINENT USERS:

Alloy Rods Co.
Arcrods Corp.
Harnischfeger Corp.
International Nickel Co.
McKay Co.
Metal & Thermit Corp.
A. O. Smith Corp.
Westinghouse Electric Corp.
and others.

ROSS SYSTEMS

J. O. ROSS ENGINEERING CORPORATION

MANUFACTURERS OF AIR PROCESSING SYSTEMS

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ROSS ENGINEERING OF CANADA, LIMITED, MONTREAL 19, CANADA • CARRIER-ROSS ENGINEERING COMPANY, LIMITED, LONDON, ENGLAND

Aldus C. Higgins

ALDUS C. Higgins, 75, for nearly a half century closely identified with Norton Company, the largest industry in Worcester, Massachusetts, and long active in the city's cultural, philanthropic and educational life, died September 10 at his home in, Worcester.

* * *

MR. Higgins, at the time of his death, was chairman of the Norton Company executive committee. His first Norton employment was as patent counsel, starting July 1, 1900. He had served in many Norton executive positions including that of president, general manager and chairman of the board of directors.

* * *

MR. Higgins was also chairman of the board of Riley Stoker Corp., and a director of Liberty Mutual Insurance Company of Boston, Worcester County Trust Company, Boston & Maine Railroad, Indian Hill Company, and Norton Company of Canada, Limited.

* * *

HE was president and a trustee of Worcester Art Museum, a trustee of the Worcester Memorial

Hospital and a life-member of the trustees of Worcester Polytechnic Institute.

* * *

MR. Higgins on his 75th birthday anniversary last December was honored by the King of Sweden during the annual Norton Company service awards party in the Worcester Memorial Auditorium. He was decorated by the King, through the Swedish Consul-General, with the Royal Swedish Order of Vasa, first class, with the rank of Chevalier. The decoration was bestowed in recognition of his outstanding contributions to industry and art. It was the last of several honors given him by the governments of both Sweden and Finland.

* * *

MR. Higgins was born in Worcester, December 7, 1892, son of Milton Prince Higgins, one of the founders of Norton Company, and Katharine Elizabeth (Chapin) Higgins.

* * *

HE was educated in Worcester, and received a bachelor of science degree from Worcester Polytechnic Institute in 1893 and an honorary doctorate in engineering from W. P. I. in 1931.

* * *

MR. Higgins, always interested in the technical side of the manufacturing business, invented the water-cooled electric furnace which made possible the commercial production of Alundum abrasive and was awarded the John Scott Medal in 1913 by Franklin Institute for this outstanding invention.

* * *

Standard Machinery Company Enters Extrusion Machine Field

THE **Standard Machinery Company** of Mystic, Connecticut, has just announced that **Ben Davis**, former well known representative of John Royle & Sons and later eastern representative of the McNail Machine & Engineering Company and the Hartig Engine & Machine Company, has been appointed Sales Manager of The Standard Machinery Company. Mr. Davis will have complete charge of sales and distribution of this new line of extruding machines for the wire and cable, plastics and rubber industries.

* * *

MR. **Edmond Spencer** has also joined the organization as Mechanical Designer. Mr. Spencer is a graduate mechanical engineer, has been associated with the American Locomotive Company, Commonwealth Steel and The Electric Boat Company in various engineering capacities.

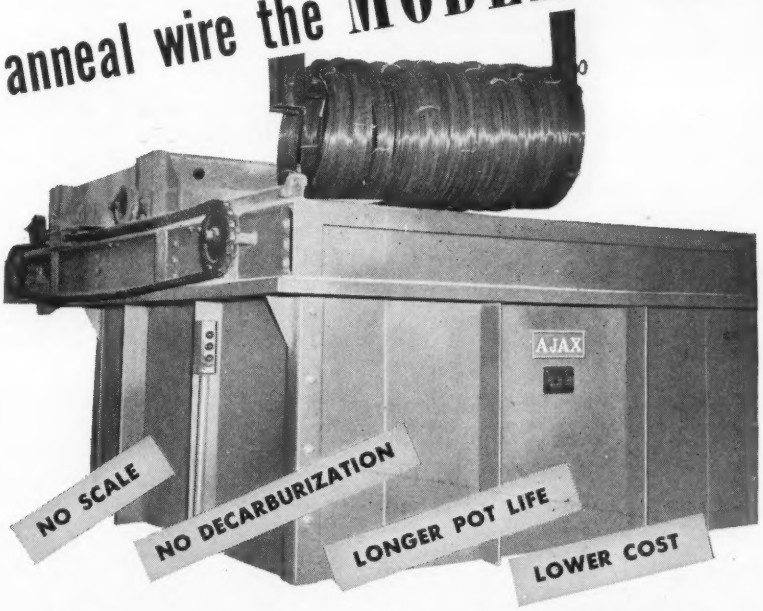
A complete line of extruding machines will be produced including strainers and a complete line of accessories.

* * *

STANDARD Machinery has a well equipped plant for this type of work with adequate facilities for expansion. This company is in its 101st year of operation and originally built many of the reciprocating steam engines and boilers used in early steam powered vessels. Other products produced through the years have been cotton gins

(*Please turn to page* 997)

anneal wire the MODERN way!



You'll save money, you'll improve efficiency along many lines with the unique Ajax Electric Salt Bath wire annealing method. It requires less floor space, less labor, less maintenance. Heating cycles average less than 20 minutes, even on difficult jobs. There is no scaling, no decarburization, no explosion hazard, none of the bothersome problems entailed with atmosphere equipment. Salt bath treating does the work faster, better, cheaper!

Ideal for annealing low- or high-carbon and stainless steel wire and rod; annealing aluminum, and copper and silver alloys; and for descaling stainless and alloy steel wire in molten salt baths.

AJAX ELECTRIC COMPANY, INC.
Frankford and Delaware Aves. · Phila. 23, Pa.
The World's Largest Manufacturer of Electric Heat Treating Furnaces Exclusively

WRITE FOR YOUR COPY!
This 72-page Ajax booklet tells the entire story of salt bath heat treatment as applied throughout modern industry. Ask for Booklet 116.

AJAX HULTGREN ELECTRIC SALT BATH FURNACE

(*Continued from page* 894)

tions used in wire drawing are based principally on our observations of mill practice. It is realized that individual mill conditions may vary from plant to plant necessitating some adjustments in operating technique or lubricant application for any given job to secure optimum results.

* * *

HOWEVER, the general observations made here should hold true for a majority of operations encountered. Application procedure in using compounds plays an important part in utilizing their merits. Care in preparation of emulsions, cleaning of central systems, introduction of the emulsion or oil in the system and maintenance of the fluid in service pay dividends in better, more economical performance.

* * *

IN preparing solutions or emulsions for use, paste type compounds should be mixed with hot water (temperature 160°F.) and good mechanical agitation used to insure a uniform mixture. Quite often, a heavy slurry of compound and water is first prepared and then diluted back to the concentration desired for service. In circulating systems, such as in wet wire drawing, thorough mixing procedure is extremely important for the right results.

* * *

OLD sysems should be carefully cleaned when the batch is changed, to insure removal of deposits of solids, soaps, metallic fines and other contaminants. If there is any reason to suspect bacteria contamination, the system should be flushed and treated with a good water soluble germicide solution before putting in the new fluid.

* * *

WITH oil type lubricants, of course, some of the precautions cited do not apply. However, a clean system to start with is always good practice.

* * *

COMPOUNDS on hand in the mill should be stored in tight containers with the covers on at all times except when securing supplies. They should be stored indoors preferably, not under leaking pipes or tanks, and not exposed to ambient temperature extremes such as direct summer sun or freezing weather. This is particularly important with water soluble compounds and oils containing soaps, fats and water.

* * *

MAINTENANCE of fluids in machines and central systems is ordinarily well regulated in most mills. The importance of checking and adjusting soap-fat concentrations in water solutions and emulsions is common practice in the wire industry.

* * *

IN conclusion, it will probably be of interest to summarize the data on the various compounds and lu-

WIRE WEAVING LOOMS FOR INDUSTRIAL WIRE CLOTH

FLY SHUTTLE LOOMS

Offers many important new features

All steel welded construction for rigidity and long satisfactory service.

Precision in workmanship, operation and production.

Built in

Standard Models 3′, 4′, 6′, 8′, 10′, 14′ or to your special specification.

Years of rigorous field service have demonstrated their superiority.

Write your requirements to

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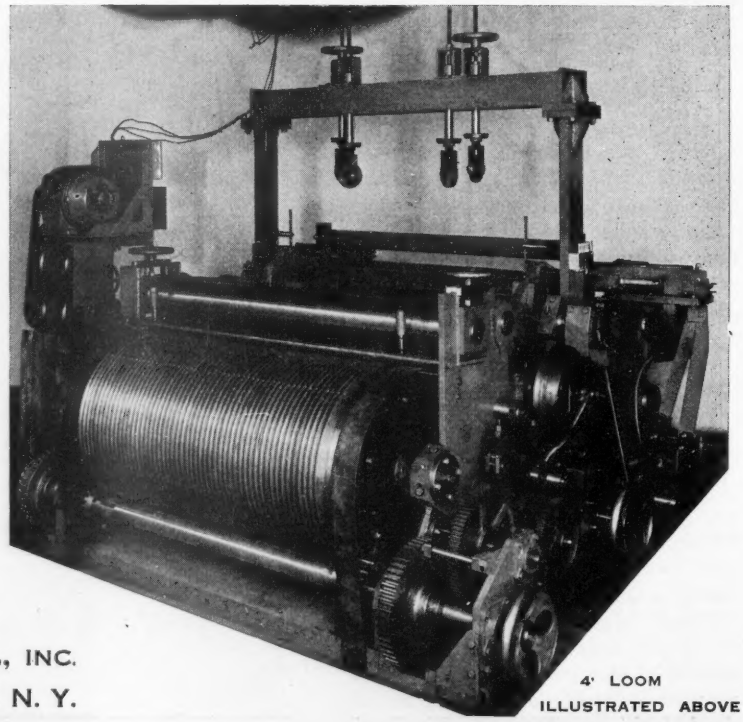


4′ LOOM ILLUSTRATED ABOVE

bricants discussed in this paper. Such summary in a recommendation form is appended hereto:—

WIRE DRAWING COMPOUND RECOMMENDATIONS

Metal Drawn	Application Method	Percent Concentration Soap-Fats Min.	Max.	Type Drawing Compound	Pounds Comp./Gal. Water
I. FERROUS					
Carbon Steel Alloy Steels (Lime Coated	Dry Soap	100	100	Dry Soap	No Water
Carbon Steel	Wet Wire	1.5	3.0	Type 1	0.2-0.3
Alloy Steels (May be lime coated)		1.5	3.0	Type 1a	0.2-0.3
II. NON-FERROUS					
Copper & Brass Heavy Wire	Wet Wire	4.0	6.0	Type 2	0.5-0.75
Copper & Brass Medium Wire	Wet Wire	2.0	3.0	Type 2	0.3-0.4
Copper & Brass Fine Wire	Wet Wire	0.5	2.0	Type 3	0.1-0.3
		0.5	2.0	Type 4	0.1-0.3
Aluminum-Heavy	Circulation	—	—	Type 5	No Water
Aluminum-Medium	Circulation	—	—	Type 6	No Water (note)
Aluminum-Fine	Circulation	—	—	Type 7	No Water

Note: Soluble type also used 0.5-1.0 #/gal. water for circulation through dies when wire precoated with neat oil before drawing.

TYPE DRAWING COMPOUND

Type 1 — Steel Wire Drawing Compound containing soaps, fats and water. High fat and free fatty acid are recommended.

Type 1a — Steel Wire Drawing Compound containing high soaps and emulsifier base. Low fat content, low free fatty acid, use for lime coated wire.

Type 2 — Copper Wire Drawing Compound similar to Type 1 except low free fatty acid, and may contain inhibitor to prevent "green scum" formation.

Type 3 — Copper Wire Drawing Compound of high soap type to be used in conjunction with Type 2 compound for fine wire drawing. Low free fatty acid. May contain inhibitors.

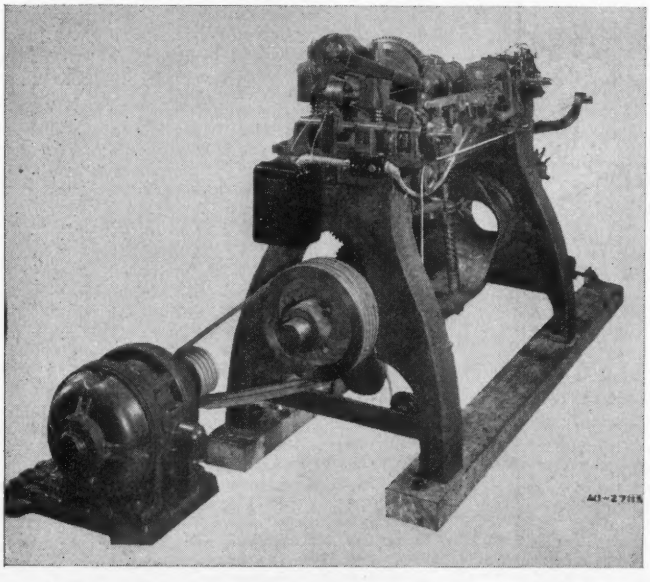
Type 4 — Copper Wire Drawing Compound or Fluid for fine wire drawing. Similar to combination of Types 2 and 3. High soap content, low free fatty acid.

Type 5 — Aluminum Wire Drawing Oil of S.S.U. viscosity 2,000–3,000 @ 100°F., for heavy wire draws. May be compounded type.

Type 6 — Aluminum Wire Drawing Oil of S.S.U. viscosity 200-600 @ 100°F. for medium wire draws.

Type 7 — Aluminum Wire Drawing Oil of S.S.U. viscosity 100-200 @ 100°F. for fine wire draws.

GLADER BARBED WIRE MACHINE



Used Throughout the World

Machine can make 2-point or 4-point Barbed Wire. Both types can be made on the Glader Combination Machine. Changeover requires about 15 minutes.

Maximum production — One man can operate two machines easily, efficiently.

Glader Barbed Wire Machine also makes 2-strand plain cable wire, without barbs.

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EXPORT DEPARTMENT, WM. GLADER MACHINE WORKS

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A Review of Recent Wire Patents

No. 2,446,292, INSULATED ELECTRICAL CONDUCTOR, patented August 3, 1948 by Edmond S. McConnell, Scarborough, N. Y., and Winfred K. Priestley, West Barrington, and Victor F. Volk, Bristol, R. I., assignors to United States Rubber Company, New York, N. Y., a corporation of New Jersey.

It is stated the conductor has excellent abrasion, flame and moisture resisting properties and that the insulation adjacent the end of the wire can be readily slid back to expose the wire end. A ribbon-like serving of fiber glass is wound in short spirals about the wire with other coverings thereover.

★ ★ ★

No. 2,446,387, SHIELDED CABLE, patented August 3, 1948 by Thomas F. Peterson, Shaker Heights, Ohio.

A cable suitable for X-ray voltages is provided including an insulated wire conductor and a non-insulated wire enclosed within and contacting a jacket (comprising a carrier of insulating character) along its length.

Complete Description and Drawings of Patents May Be Had for 50 cents, outside the United States and Canada $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

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MINIMIZE EMBRITTLEMENT *with* Rodine®

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Philadelphia, Pa., October 25—29, 1948

Pioneering Research and Development Since 1914
AMERICAN CHEMICAL PAINT COMPANY
AMBLER, PA.
Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

No. 2,446,608, MACHINE FOR BENDING WIRE INTO RIBBON FORM, patented August 10, 1948 by Karl E. Queitzsch, York, Pa.

The machine comprises a vertical support, bearings adjacent the support, a pair of shafts rotatably and slidably mounted in the bearings, these shafts being normal to the support, means biasing the shafts toward the support, a first forming arm carried on the end of one of the shafts, a second forming arm carried on the end of the other shaft means for rotating the shafts in opposite directions and arranged so that the forming arms move inwardly in alternate sequence, these forming arms slidably bearing on the support during inward movement thereof, and a clamping plate pivoted to the support, with the plate being spaced from the support at its pivotal plane, each forming arm being arranged so as to engage this plate at the termination of its inward movement, so as to exert clamping pressure on it.

★ ★ ★

No. 2,446,755, SPRING WINDER, patented August 10, 1948 by Jesse A. Gates, Royal Oak, Mich.

This is a manually-operated device for winding wire lengths into spiral springs.

★ ★ ★

No. 2,446,820, APPARATUS FOR TESTING ELECTRIC CABLES, patented August 10, 1948 by Richard D. Gambrill and Clay E. Lewis, Baltimore, Md., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

For testing cables while under tension, the inventors provide, in conjunction with a test set, a frame having a cross beam at its top, an air cylinder supported by the cross beam, a clamp carried by the piston of the cylinder for securing a cable, including an electrical conductor to be tested, a weight positioned directly below the cylinder, a device carried by the weight for securing a cable thereto, whereby the weight is lifted to tension a cable secured by the clamp and the securing device when the clamp is raised by the piston and clamps for connecting the ends of the conductor of the cable to the test set.

★ ★ ★

No. 2,447,154, METHOD OF MAKING TORPEDO NETS, patented August 17, 1948 by Alan E. Brickham, New Haven, Conn., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

The method comprises placing a number of stranded wire structures of a length equal to the width of the unspread net side by side in parallel relationship, progressively passing double-barreled sleeves over adjacent stranded structures from the center outwardly to each end, spacing the sleeves at the desired position along the stranded structures to obtain the desired openings in the finished net, thereafter applying sufficient pressure to the sleeves to secure them to the stranded structures, and spreading the net by putting a permanent bend in the structures in the plane of the net at the point where they leave the sleeves.

★ ★ ★

No. 2,447,155, METHOD AND APPARATUS FOR SWAGING AND BEND-

ING, patented August 17, 1948 by Alan E. Brickman, Worcester, Mass., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

This patent includes a machine for fastening a sleeve (such as that of patent 2,446,820) on two stranded wire structures in the manufacture of the net described.

★ ★ ★

No. 2,447,168, HIGH-FREQUENCY ELECTRIC CONDUCTORS AND CABLES, patented August 17, 1948 by John Norman Dean, Westerham, Esmond Wassell Smith, Beechcroft, Chislehurst, and Reginald Scar, London, England, assignors to Telegraph Construction & Maintenance Company, Limited, Greenwich, London, England.

Included are two balanced conductors together surrounded by a dielectric comprising a tape including a layer of non-conductive flexible material and a thin layer of metal wound upon the dielectric with overlapping turns with the thin layer of metal facing toward the inside of the cable and being in intimate contact with the dielectric, and a flexible conductive reenforcing layer immediately covering this tape.

★ ★ ★

No. 2,447,444, GROUND STAKE, patented August 17, 1948 by Philip M. Waite, Corry, Pa.

The stake is made up of a single length of rigid wire.

★ ★ ★

No. 2,447,531, METHOD OF SIMULTANEOUSLY BEAMING AND ELECTRO-PLATING WIRES, patented August 24, 1948 by Robert C. Pierce, Niles, Mich., assignor to National-Standard Company, a corporation of Michigan.

Instead of separate operations, the method provides for electroplating a number of wire strands and winding them upon a common spool.

★ ★ ★

No. 2,447,613, WIRE COIL CONVEYER BELT, patented August 24, 1948 by Frederick W. Hale, Worcester, Mass., assignor to Ashworth Bros., Inc., Worcester, Mass., a corporation of Massachusetts.

This belt is made up of a reenforcing cross rod extending through the interlocked portions of adjacent intermeshed coils and having a longitudinal series of annular grooves providing transversely spaced shouldered abutments, with the grooves being spaced apart to correspond to the pitch of the wire coils.

★ ★ ★

No. 2,447,841, TAPING HEAD FOR CABLE INSULATING MACHINES, patented August 24, 1948 by Carl O. Bruestle, Rahway, N. J., assignor to Syncro Machine Company, Perth Amboy, N. J., a corporation of New Jersey.

More specifically, the invention including a braking device secured to a shaft which also carries the tape reel.

★ ★ ★

No. 2,448,009, INDUCTIVE HEATING OF LONGITUDINALLY MOVING METAL STRIP, patented August 31, 1948 by Robert M. Baker, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania.

In a preferred form of the invention, the magnetic flux lines pass through the strip in the direction of the strip-thickness or normal to the wide faces or sides of the strip.

No. 2,448,011, METHOD AND APPARATUS FOR INDUCTION HEATING OF METAL STRIPS, patented August 31, 1948 by Robert M. Baker, Pittsburgh and Gaylord W. Penney, Wilkinsburg, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania.

The strip material is raised from temperatures at which it is ferro-magnetic to temperatures above that at which it becomes paramagnetic.

★ ★ ★

No. 2,448,463, METHOD OF MAKING BRAIDED SLINGS, patented August 31, 1948 by David S. Robbins, Hamden, Conn., assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

This method is for forming an eight-part sling from a left-lay rope and a right-lay rope comprises arranging the ropes into a V-shape with each leg of the V having two parallel parts of left lay rope and two parallel parts of right lay rope, leaving an eye at the apex of the V, gripping the ropes at the apex, braiding the pairs of ropes together with the ropes in each pair remaining parallel, the braiding being maintained in one direction throughout, forming a second eye at the end of the braiding, and splicing the free ends of each rope together to form an endless unit after braiding is completed.

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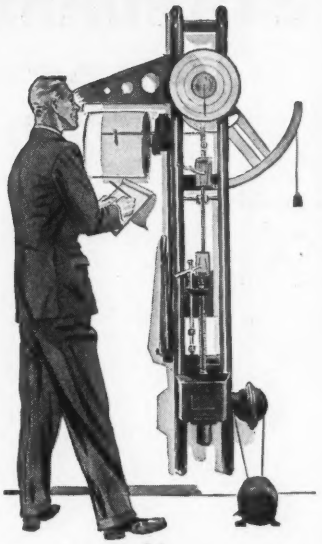
*Scott Testers for WIRE

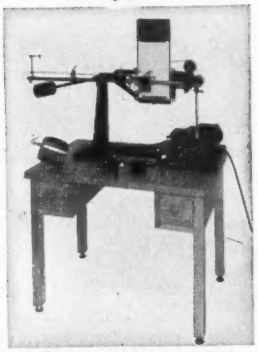
J-5, Standard for Tire and Spring Wire



J-5

For wires as fine as 4 grams tensile strength, and for heavy wires up to 1 ton tensile, *Scott Testers provide a range of machines for all standards tests, plus the Scott feature of "picturized" result graphs.

IP-2, Standard for Grid Wire



IP-2

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Auto-Lite Acquires Additional Plant Facilities

THE Electric Auto-Lite Company of Toledo, Ohio, has announced the signing of a contract for the purchase from the War Assets Administration of the former Wright Aeronautical Plant at Lockland, Ohio.

* * *

UNDER the contract, Auto-Lite took immediate possession of the huge plant, which occupies an area of about 200 acres, and will acquire title to about 4,500,000 square feet of floor area.

* * *

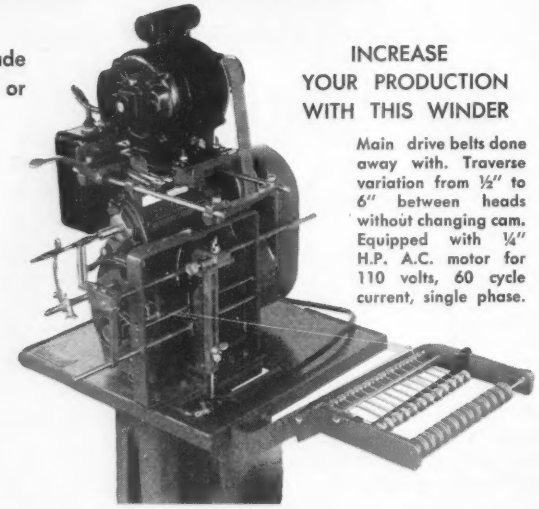
UNDER the terms of purchase, the Government retains ownership of the 3 foundry buildings, totaling approximately 900,000 square feet, at the South End of the property. It is proposed that Auto-Lite maintain these properties for the Air Force in standby condition, under contract.

* * *

SIMULTANEOUSLY with the acquisition by Auto-Lite of this property, a lease covering the North Shop is being made with the General Electric Company for the production of jet propulsion engines under the Government's Defense Program. This permits the use by Auto-Lite of approximately 3,500,000 square feet for manufacturing purposes. In conjunction therewith Auto-Lite will maintain and operate all facilities for the furnishing of such utilities as water, power, and gas for the entire project.

STANDARD UNI-DRIVE WIRE WINDER

Spindle can be made to fit any spool or bobbin required. Photo is for a wardwell braider bobbin.



INCREASE YOUR PRODUCTION WITH THIS WINDER

Main drive belts done away with. Traverse variation from ½" to 6" between heads without changing cam. Equipped with ¼" H.P. A.C. motor for 110 volts, 60 cycle current, single phase.

Increase your production with this winder. Incorporates many valuable new features. Winds up to 10 ends on each spool. New micrometer variable traverse motion winds evenly between heads. No more hollow shaped spools or bunching of wire next to heads. Geared wind produces straight parallel wind which eliminates jumping of guide on braider latch. Starts slow. Makes possible greatly increased production.

Over 500 of these winders in successful operation. You should have full information on this winder in your files. Please write to nearest office for particulars.

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P. O. BOX 1534, PROVIDENCE, R. I.

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Southern Office: Southern Standard Mill Supply Co., Charlotte, N. C.
New York Office: 6708 Empire State Bldg., 350 Fifth Ave., New York, N. Y.

New Acromark Fixture Holds Special Shapes

TO position, clamp and quickly release special shapes of name plates for stamping them with lettering or numbering, The Acromark Company, Elizabeth, N. J. has developed a new fixture.

* * *

THIS fixture is adaptable to the holding of a wide variety of shapes and sizes of plates, and can be used in any type of press or the Acromarker Name Plate Stamping Machine.

* * *

IT is furnished with a flange at the rear to fit under the stamping bar of standard machines or may be boiled into position for special applications.

* * *

IN operation, the special name plate is placed flat on the fixture when the front rod handle of the lever arrangement is lifted. Upon release of the rod, spring pressure holds the plate in position assisted by four small pins that move upward and lock the plate firmly.

* * *

A series of holes in the spring pressure bar permits locating the pins to suit the shape of the special plate or plates. To remove the plate after stamping, the rod is simply lifted and leaves the name plate free to be removed by a slide motion of the operator's hand.

* * *

THE fixture is available in several sizes to suit larger or smaller name plates.

* * *

LITERATURE now available. Delivery, one week.

Wiegand Announces All-Metal Electric Radiant Heaters

HIGH heat intensity and utilization of almost the entire infrared band result in a new and improved type of infra-red heating with the rugged Chromalox all-metal electric radiant heaters have been announced by **Edwin L. Wiegand Company**, Pittsburgh. These glassless, glareless heaters were designed for drying, baking, preheating and dehydrating where a longer-wave infra-red heat source is desired and where rugged, all-metal construction is preferable.

* * *

THE new heater has a high-temperature enclosed type Chromalox heating element mounted in a rigid extruded aluminum body with a very efficient reflector sheet of highly polished Alzaked aluminum, which can be easily cleaned or replaced if necessary. Tongued and grooved sides and two sliding captive bolts facilitate fabrication of heater sections into various working patterns.

* * *

THE heating elements are mounted at the focus of a parabolic reflecting surface, which results in maximum heat radiation uniformly distributed over the surface to be heated. A negligible amount of visible light is produced from the Inconel-sheathed tubular electric heating unit which operates at temperatures of 1000° to 1400°F., depending upon wattage of the heating element. The user has a choice of wattage ratings to suit his operating conditions and to accomplish the results desired.

* * *

FOR more information, write Edwin L. Wiegand Company, 7500 Thomas Boulevard, Pittsburgh 8, Pennsylvania.

* * *

Bulletin Describes Improved Variable Speed Motors

PRESENTATION of new model U. S. Varidrive motors is made in a factful Bulletin just issued by **U. S. Electrical Motors, Inc.** The Varidrive, which enables a machine operator to obtain infinite speeds, is shown in natural colors in different capacities. This 16-page Bulletin is attractively compiled and shows in dramatic form how a variable speed motor can be applied to countless operations, to reduce operator fatigue and appreciably increase production. Interesting graphs and illustrations show new ways in which variable speed can be used with savings in man hours and in obtaining better production. A diaphanous view of the Varidrive shows its operating principle. Supplementary drawings detail major improvements in design. A copy of this Bulletin may be obtained by writing to U. S. Electrical Motors, Inc., 220 East Slauson Ave., Los Angeles 54, Calif.

TO WIRE MILL MEN
Have you considered joining the Wire Association? You are cordially invited to become a member. Dues are $15.00 a year, which includes a subscription to WIRE & WIRE PRODUCTS and a copy of the Annual Buyers Guide.
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Material Handling Trucks in the Wire Mill

TWO constantly recurring tasks of transport, involving (a) the movement of coils, or small reels, of wire from the warehouse into the production line and, (b) movement of huge six-foot-diameter wooden reels of wire rope, from factory floor into warehouse, or into freight cars for outward shipment, are performed in a western wire rope plant by means of storage battery-powered industrial trucks. Such trucks have been employed by the company for these purposes since 1933 and perform

Fig. 1 — Storage battery-powered, lowlift platform truck, with rated load capacity of 4,000-lb., transports 61 coils of wire — (approximate weight of load 7,500-lb.) — from storage area into production line at wire rope plant. Western firm, where above picture was taken, has used battery-powered industrial trucks for more than 15 years in its factory and warehouse operations, with no reported mechanical failures despite frequent excessive weight lifting-and-transport demands made upon them. * * *

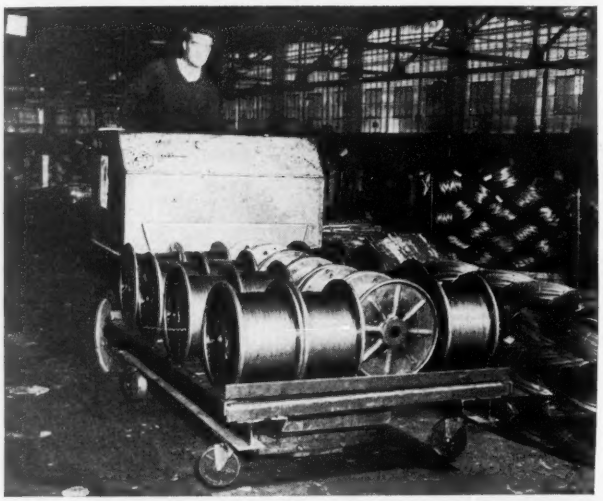


Fig. 2 — Reels of wire, used in manufacture of wire rope and cable, are transported by battery-powered lowlift platform truck on a special type of four-wheeled "live" skid, which will be placed adjacent to strand spinning machines. * * * * * *

their duties with ease and facility, despite the fact that some of the wooden reels with their content of wire rope weigh 19,500-lbs. or more.

* * *

THE work of handling and moving material at this plant is divided between two battery-powered industrial tractors, and two lowlift platform trucks. The latter are of 4,000-lb. capacity, and to them falls the bulks of the "pick-up, move and deposit" operations. Although rated to be of two-ton capacity, the little trucks at times lift and move

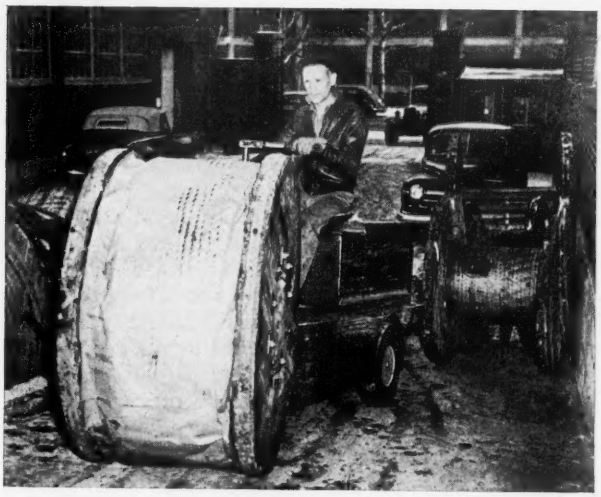


Fig. 3. — "Bucking" a 19,500-lb. reel of wire rope from factory floor to warehouse by means of a storage battery-powered tractor. Movement of these six-foot diameter reels over 300 foot distance, including steep 30-foot ramp, is performed in less than five minutes. Tractor operator rolls these reels much as a child would roll a hoop, and negotiates 90-degree turns without appreciable slow-up of forward movement. * * *

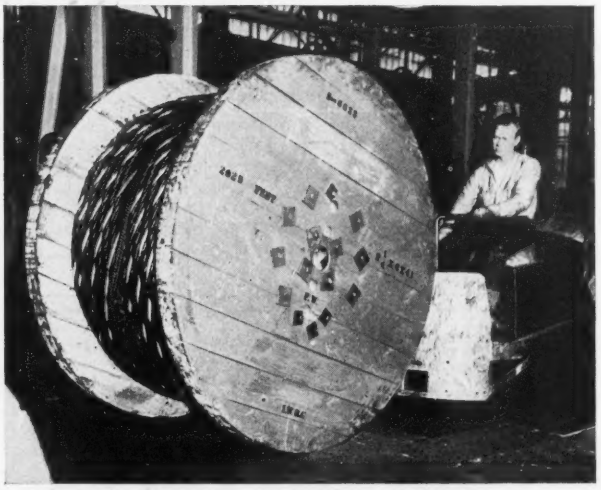
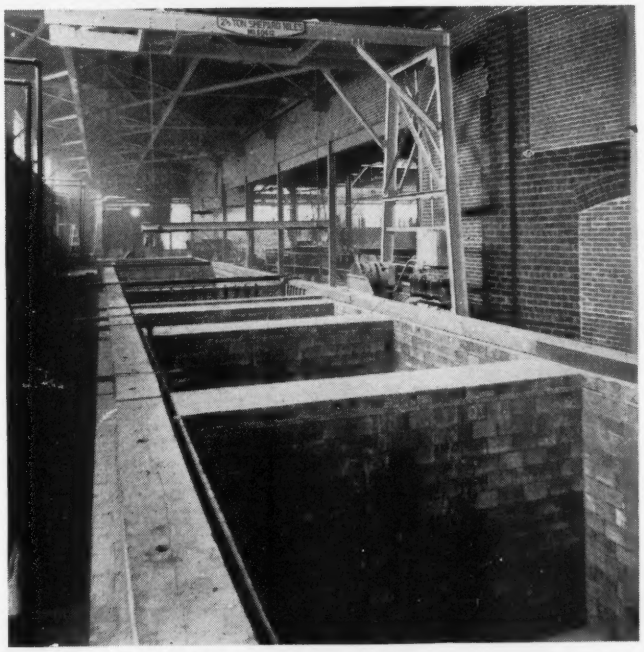


Fig. 4. — A 30-foot ramp, with a rise of 4½ feet in its length, presents no difficulty in moving reels of wire rope from production floor to warehouse at this Western wire rope plant, when storage battery-powered tractor — (shown above) — is used. Tractor's operator "bucks" the huge reel with front of his machine, and huge 19,500-lb. load responds like a child's hoop. Battery-powered industrial trucks have been used at this plant for more than 15 years and management reports that despite excessive work demands made on equipment there has never been any "down time" due to mechanical failure. * * * * *

Maintenance *COSTS LESS* with NUKEM PICKLING TANKS



The sound, acid-proof construction employed in Nukem pickling tanks results in installations which give fine, trouble-free service for years. Each tank is designed to meet the specific conditions for which it is to be used. As a result, maintenance costs are reduced to a minimum, and long, trouble-free service is the rule.

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skid-loads of wire, of a total weight of as much as 7,200-lbs.

* * *

"WE know that this weight is greater than that at which the trucks are rated," the plant superintendent said recently, adding, "and we realize that it is not good practice to call upon a piece of machinery to operate beyond its 'performance-guarantee', but our practice in overloading is dictated by necessity. At intervals we have to supply material in quantity within a specified period, hence we call on our trucks to carry loads in excess of their rated capacity." He went on to explain that such "overcapacity" movement is the exception rather than the rule, but that the battery-powered truck equipment "has never failed in performance" when called upon for such service.

* * *

MOVEMENT of the heavy reels, at one time, was done by means of a special four-wheeled reel-carrying trailer, hauled by a battery-powered tractor. This trailer also was powered by the storage batteries that powered the tractor. Within the last few years, however, use of the trailer has been abandoned in favor of "bucking" the reels along the floor by means of the tractors, much in the manner in which a child rolls a hoop.

* * *

THE forward end of each tractor has been reinforced with heavy metal plates. Three oval-shaped rollers have been installed in the forward plate of one tractor. This permits of greater ease of operation in performing the "bucking' operation. The plate, or the roller bearing according to the respective tractor, is pushed against the periphery of the cable reels, the latter rolling ahead of the tractor.

* * *

IN movement from the factory floor to the warehouse area a ramp, with a rise of 4½ feet in 30, is negotiated. At the head of the ramp there is a 90-degree turn to permit access to the warehouse area. The tractor's operator made this turn by pushing against one side of the reel and spinning it on its axis for further forward movement. So adept have the operators become in this procedure that the distance from factory floor to warehouse — some 300 feet, including three doorways, four 90-degree turns and the ramp — is covered in less than five minutes.

* * *

THE same practice is following in loading box cars, the tractor pushing the reel from the loading platform into the car and positioning it. The reels are chocked in place to prevent shifting in transit.

* * *

THE coils of wire handled by the platform trucks are carried on skids. These are provided with end-guards, and carry an average of between 50 and 60 coils to the skid-load. The smaller metal reels of wire, each weighing between 225 and 275 pounds, are carried on a special type of four-wheeled, or "live" skid. Approximately 18 reels are carried in one load.

All Metal
WIRE SPOOLS

Light weight, all-steel, lithographed.
5", 6½", and 10½" diameter ends.
Ends and traverses may be shipped unassembled.

We also produce spools for fine and magnet wire.

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New Specifications for Arc-Welding Electrodes and Plastics

Electrodes

INDUSTRIAL users of arc welding will be interested in the four specifications for arc-welding electrodes recently completed by the Committee on Filler Metal, jointly sponsored by the American Welding Society and the American Society for Testing Materials.

* * *

THE **Tentative Specifications for Mild Steel Arc-Welding Electrodes** and **Tentative Specifications for Low-Alloy Steel Arc-Welding Electrodes represent** a division of the old Tentative Specifications for Iron and Steel Arc-Welding Electrodes. The mild steel specifications include all classifications in the E60 series generally intended for welding mild steel. The low-alloy specifications include all classifications in the E70, E80, E90 and E100 Classifications intended for welding low-alloy steel and generally containing suitable alloying elements to match the analysis and properties of these low-alloy steels. Classifications have been added in both specifications to cover the so called "low-hydrogen" electrodes. Another innovation in these specifications which should make them much easier to use is the rearrangement of specification requirements so that all provisions concerning "classification and acceptance" such as test results, standard sizes and lengths, and packaging have been grouped together. The details of testing have been similarly grouped together. By this separation of requirements, the user can more readily determine the classification best suiting his needs, without having to turn pages back and forth as was necessary under the old arrangement where each requirement was given directly followed by the details of test involved.

* * *

EACH specification contains a Guide to the Classification of Electrodes as an appendix. This guide was first introduced in the 1945 edition and was very well received. The information is intended to supplement the specifications and provide the user with information which will further assist him in determining the classification which will best suit his needs.

* * *

THE **Tentative Specifications for Corrosion-Resisting Chromuim and Chromium-Nickel Steel Welding Electrodes** first issued in 1946, have been expanded so that 40 classifications, covering over 85 percent of the stainless electrodes used now are included. There are ten series of four classifications each, including E308, E309, E310, E316, E317, E330, E347, E410, E430 and E502, which parallel the base metals of similar AISI number. The requirements have been rearranged as described above, and a Guide to the Classification of Electrodes is included.

* * *

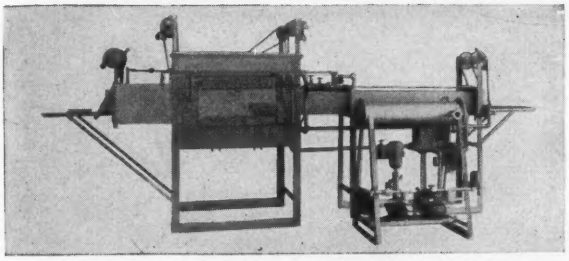
THE **Tentative Specifications for Copper and Copper-Alloy Metal-Arc Welding Electrodes** is the first in a series of specifications to be issued for copper and copper-alloy

1926 – pioneered the first practical controlled-atmosphere furnace

"Certain Curtain" ELECTRIC FURNACES

TODAY – providing the most advanced types of controlled-atmosphere furnaces

"CERTAIN CURTAIN" ELECTRIC FURNACES



TYPE LA

For CLEAN annealing, copper brazing, silver soldering in Controlled Atmosphere

The famed "Certain Curtain" control conquered the most difficult atmospheric problems in high speed steel treating. These same patented methods are available in equipment expressly designed for clean annealing, copper brazing and silver soldering at temperatures up to 2000°F. Conveyor and batch types. Additional external atmosphere generator available. "Certain Curtain" equipment dissociated ammonia or hydrogen assuring the utmost in economical protection for every operation.

AVAILABLE ALSO IN CONVEYOR TYPES AND IN VARIOUS CAPACITIES

Write for "CATALOG 108"

C. I. HAYES, INC. 129 Baker St., Providence, R. I.

filler metal. Following the standard pattern of requirements and arrangement it includes classifications for copper, phosphor-bronze, copper-nickel, copper-silicon and aluminum-bronze materials. Arc welding of these copper alloys has increased considerably and these new specifications are expected to meet the need for suitable classification of the filler metal used. The Guide in these specifications should be specially helpful.

* * *

INDIVIDUAL copies of all of the above specifications are available from either the American Welding Society, 33 West 39th Street, New York 18, N. Y., or The American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at 25 cents each.

Plastics

THE new method of Measuring Shrinkage from Mold Dimensions (D 955) will provide a reliable method for comparing the results on plastic materials, and the procedure is intended to cover batch-to-batch uniformity in initial shrinkage. The new Tentative Recommended Practice for Molding Specimens of Amino Plastics (D 956) provides a method for which there has been a demand from both consumers and producers of these materials. Requirements are given for impact, flexural, and water absorption test specimens, etc. The new Recommended Practice for Determining Mold Surface Temperature of Commercial Molds for Plastics (D 957) is intended for determining the temperature at a specified point or points on the surface of the cavity and plunger of a commercial mold for plastics. By determining the temperatures at as many points as deemed necessary, the over-all temperature condition of the surfaces can be determined. The other new Recommended Practice D958 covers two optional procedures for determining the temperature condition of standard A.S.T.M. molds for test specimens of plastics by means of either a thermometer or a pyrometer.

* * *

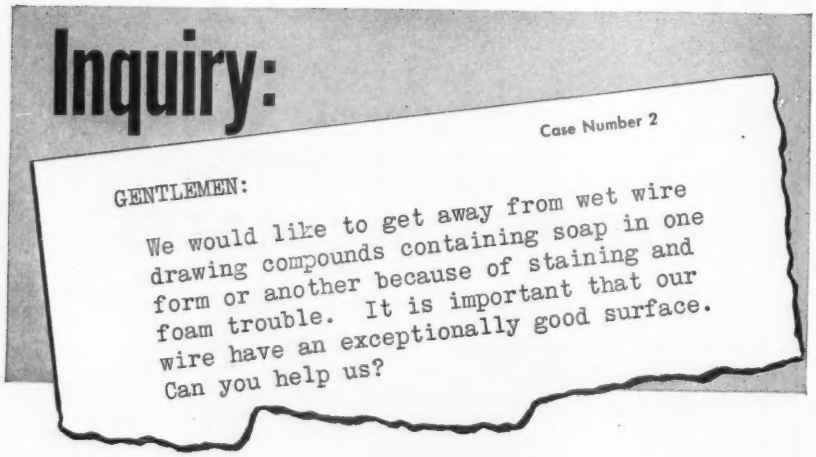
REVISIONS in the Test for Deformation of Plastics Under Load (D 621) include the addition of a section on the significance of the test, a new section covering a limiting value of deformation, and other changes bring the requirements in line with best current practice.

* * *

THE new Tentative Method of Test for Bond Strength of Plastics and Electrical Insulating Materials (D 952) has important application in the evaluation of ply adhesive strength of sheet plastics and electrical insulation. It is applicable to such materials as laminated phenolics, laminated melamine with glass fabric base, and vulcanized fiber.

The Best of Everything for Metallizing

THE **Metallizing Engineering Co., Inc.**, 38-14 30th Street, Long Island City 1, New York, announces a new catalog of its complete line of metallizing equipment and supplies under the above title.


Inquiry:
Case Number 2
GENTLEMEN:
We would like to get away from wet wire drawing compounds containing soap in one form or another because of staining and foam trouble. It is important that our wire have an exceptionally good surface. Can you help us?

Answer: Our answer to this and similar inquiries is the extensive research program now being conducted by NOPCO* LABORATORIES to effect improvements in NOPCO'S Wire Drawing Compounds.

These improvements include (1) changing the structure of the fats and oils in these compounds, thus enabling them to create a *stronger* bond between metal and lubricants . . . and (2) the production of more *stable* fatty compounds.

NOW IN PRODUCTION. These special research projects *supplement* rather than *supplant* NOPCO'S regular activities in the production of metal working products. NOPCO Wire Drawing Compounds are available now.

Wire Manufacturers: Perhaps we can answer your wire drawing problem. Write us.

*Reg. U.S. Pat. Off.

NOPCO CHEMICAL COMPANY, Harrison, N.J.
FORMERLY NATIONAL OIL PRODUCTS COMPANY
Branches: BOSTON • CHICAGO • CEDARTOWN, GA. • RICHMOND, CAL.
NOPCO EVOLVED THRU RESEARCH

SINCE its founding, METCO has aimed at giving the users of metallizing equipment one source of supply for all their metallizing needs. That ideal has now culminated in the printing of this new, useful and easy-to-read eight page catalog, which gives a most complete listing of metallizing equipment, accessories and supplies. In it will be found described metallizing guns for every purpose, air and gas controls, spray booths and dust collectors, blast machines and nozzles, and air compressors to give you clean, dry air. Each piece of equipment is illustrated. There is also a description of each of the special METCO metallizing wires.

* * *

THREE new accessories are introduced. (1) A Wire Control and Straightener Unit to increase spraying speeds and reduce wear on the gun. (2) A Gas Flow Meter Unit, the first of its kind, to assure maximum efficiency, higher spraying speeds and greater gas savings. (3) An Air Control Unit that assures properly controlled air pressures.

* * *

YOU will find these new accessories and the complete line of METCO Equipment, Accessories, Wires and Supplies in Catalog 401. You are invited to write for a copy.

New Booklet is "First Aid" In War on Corrosion

TO help industrial designers, engineers, and buyers cut the cost of important machine components and accessories, about 200 standard products for corrosive and high temperature service are listed in a new catalogue by **The International Nickel Company, Inc.** Checked by manufacturers of each item, this new "Standard Specialties" catalogue is the first complete compilation of products made of Monel, Nickel or Inconel and available economically from stock or from standard designs.

* * *

AMONG the hundreds of "Standard Specialties" described and illustrated under 47 general classifications are balls, floats, nails, bolts, pickling slings and hooks, thermostat parts, thermocouple protection tubes, pipe and pipe fittings, gaskets, valves, cathodes, grease fittings, tags, woodruff keys, wire rope, and vibration isolators.

* * *

COPIES of this "Standard Specialties" catalogue are offered to industrial purchasing agents, engineers, product designers, and other executives concerned with purchase and product specification, through The International Nickel Company, Inc., 67 Wall Street, New York.

* * *

New Hand-Operated Degreaser With Quick-Conversion Heating

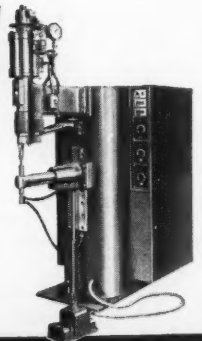
ANNOUNCEMENT of the new "625" Degreaser — a two-dip hand-operated unit designed for rapid, safe and thorough cleaning of medium-size metal parts of all kinds in machine shops, production, assembly, and maintenance departments — has just been made by

don't miss

THREE-PHASE* WELDING

at the Metal Show

BOOTH No. 1619



A "must" on your list of things to see at Philadelphia is Sciaky THREE-PHASE resistance welding. You'll see how it's possible to weld aluminum, brass, multiple cross wire jobs, etc., with ordinary power facilities—because it requires only *¼th the current* used by conventional welders. Other advantages include: *balanced three phase load* at better than *85% power factor.*

If you can't attend the show, write for literature. Sciaky Bros., Inc., 4923 West 67th Street, Chicago 38, Ill.

*Exclusive Patented Development by

SCIAKY

Detrex Corporation, Detroit 32, Michigan.

* * *

THIS unit can be heated by steam, gas or electricity, whichever is most practical at the particular time and location. It can also be furnished for combined gas-and-steam or gas-and-electric heating. A most important and unique feature of this new design of equipment is the standardization of main body construction so that it can be quickly converted from one type of heating to another where seasonal changes in heating method give added economy, or convenience.

* * *

THE degreaser employs the immersion-solved-vapor degreasing process originated by Detrex some years ago and used in many thousands of manufacturing plants where rapid, low-cost cleaning is the goal. It removes grease, oil and similar materials many times faster than other methods, and leaves all surfaces, external and internal, thoroughly clean and dry. To operate, the parts are simply lowered into boiling solvent, transferred within the machine to a cool solvent rinse compartment, and after a few seconds, they are removed through the solvent vapor zone. The Perm-A-Clor solvent used is non-flammable, and cannot burn or explode.

* * *

THIS degreaser is of all-welded construction, fabricated from 10-gauge steel plate and reinforced with structural steel. All interior surfaces are protected with a molten zinc coating which is sprayed on after fabrication. It is also available built of life-time, corrosion-resistant nickel-steel. Production capacity is rated at 1000 lbs. of steel parts per hour. Floor space occupied is about 10 sq. ft., and the net weight is approximately 500 lbs.

* * *

FURTHER details and specifications are available on request from Detrex Corporation, Industrial Division, Box 501, Detroit 32, Michigan.

* * *

New Plater's Computer

A new Jernstedt Plater's Computer, the simplified and improved 1948 model, has been developed, which is available from the **Hanson-Van Winkle-Munning Company**, Matawan, N. J.

* * *

THE new Jernstedt Computer does for the plater what a slide rule does for the engineer. In a few seconds, the user can determine:

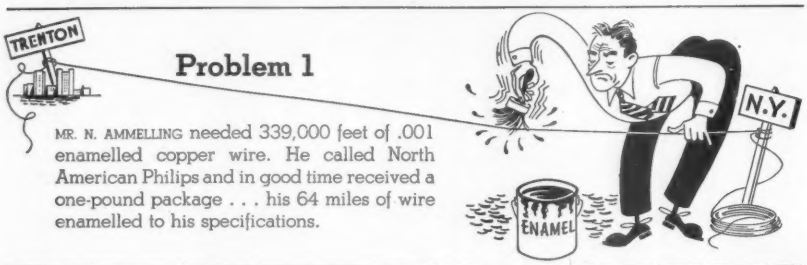
(1) Plating time required to deposit a given thickness of any metal.
(2) Current density required to produce a deposit of given thickness.
(3) Thickness of deposit resulting from an established plating time at a known current density.
(4) Usual cathode efficiencies of all modern electroplating solutions.
(5) Ampere minutes per square foot to deposit .0001" of all commonly used solutions, at usual cathode efficiencies.
(6) Temperature conversion scale, degrees Fahrenheit — degrees Centigrade.

* * *

THE Computer measures only 6¼" x 1½" and comes in an attractive vinyl carrying case. The selling price is only $2, a figure made possible by volume production and improvement in manufacturing technique.

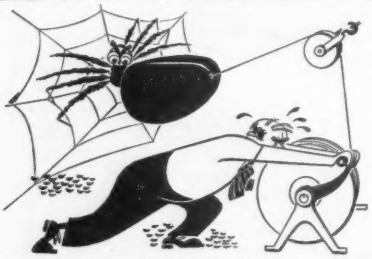
What's your problem?

Fine Wire? Tungsten? Molybdenum?



Problem 1

MR. N. AMMELLING needed 339,000 feet of .001 enamelled copper wire. He called North American Philips and in good time received a one-pound package . . . his 64 miles of wire enamelled to his specifications.



Problem 2

The firm of AL LOYS & AL UMINUM were in urgent need of fine aluminum and aluminum alloy wire for a delicate production job. Fine Wire Headquarters assured them that it was no problem at all. The order was placed, the Fine Wire delivered, and it performed to the complete satisfaction of all concerned.

Problem 3

MR. MUST B. PLATED, who required metal-clad wire for a specific application, phoned Fine Wire Headquarters. We supplied the base material to provide the physical characteristics desired, and plated it to meet his exacting specifications for special surface qualities.

the answer

WHY not call Fine Wire Headquarters when you have a question about fine wire? We can't do the impossible, but we can do lots of things that can bring you the right fine wire for the job. So—when you have a problem on Fine Wire, Tungsten or Molybdenum wire, phone or write to North American Philips, makers of NORELCO Fine Wires, and ELMET Tungsten and Molybdenum products.

NORTH AMERICAN PHILIPS COMPANY, INC.

Dept. XY-10, 100 East 42nd Street, New York 17, N. Y.

Export Rep. -:- Philips Export Corp. -:- 100 East 42nd St., New York 17, N. Y.

New Testing Machine Announced

A new type of horizontal tensile testing machine, especially designed for long specimens of rope, wire, cable, chain, belting and flexible tensional materials of any desired length is being introduced in industrial testing laboratories.

* * *

AN important feature of this machine is its unlimited stroke within the maximum distance of 25 ft. between grips, which permits high elongations. This is accomplished by means of a two-screw carriage drive. Screws on each side of the main frame of the machine are driven through speed reduction gears by a 10-hp electronically controlled, variable speed, direct-current motor. Driving speeds of 3/8 in. to 18 in. per minute can be maintained accurately in either direction of movement of the carriage by means of the electronic control. A strain rate pacing disk on the dial of the indicator permits operation at constant rate of loading if desired, instead of a constant rate of elongation. At least 6 in. per minute is available at full load.

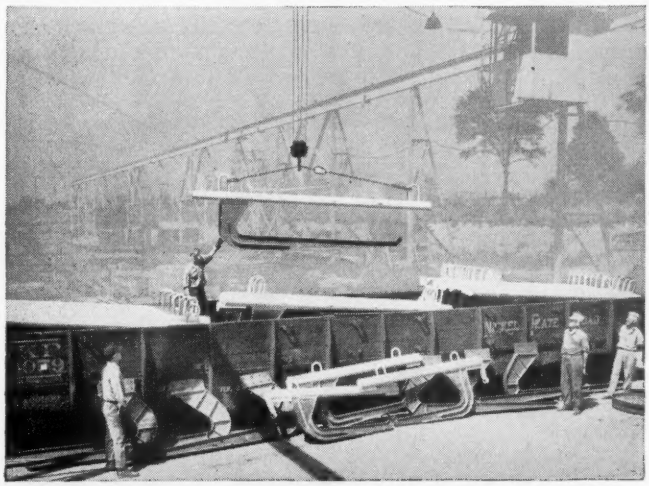
* * *

AS on nearly all testing machines manufactured by the Baldwin Locomotive Works, the well-known Emery hydraulic cell is the load sensitive element. A compression load is applied to the Emery cell by means of a yoke around the cell from the stationary head which pulls against the main frame of the machine. A standard Tate-Emery indicator takes the hydraulic pressure in a Bourdon tube that is restrained from deflecting by a pneumatic system sensitive to air pressure changes that occur when the Bourdon tube moves a baffle plate over an air jet. A pressure sensitive bellows in the pneumatic system restrains deflection of the baffle and Bourdon tube through an iso-elastic spring and thereby activates the indicator hand with the resulting extension of the highly accurate spring.

* * *

THREE load ranges are provided on the rope testing machine: 0 to 6000 lb., 0 to 24,000 lb., and 0 to 120,000 lb., each being read to an accuracy of ½ percent on a 66-in. scale on the indicator dial. The driving motor is controlled by the operator by buttons at the indicator cabinet where he can watch both test specimen and indicator dial. Satisfactory measurements of both specimens and their elongation can be made by measuring tape. However, an extensometer and recorder can be added whenever they may be required.

SEND IN
YOUR ORDER NOW
for the
1948 WIRE BUYERS GUIDE



LIGHTWEIGHT HOOKS *for* HEAVY-DUTY SERVICE

WELDCO HAIRPIN HOOKS SPEED UP YOUR PICKLING AND MATERIAL HANDLING OPERATIONS

● Here's another carload of Weldco hairpin hooks, ready for shipment to one of the country's largest steel plants. These pickling hooks are lightweight but **tough** . . . designed to handle loads as heavy as 3,000 to 5,000 pounds, easily and safely. Weldco hairpin hooks withstand hot pickling acids, too; in fact, they're more corrosion-resistant—more durable—than many heavier hooks.

Weldco pickling hooks are made of Monel, and can be furnished in various other alloys. Put these sturdy, lightweight hooks to work in your plant—then watch your pickling and material handling costs go down.

OTHER WELDCO PICKLING PRODUCTS
Include Pickling Crates, Baskets, Chains, Jets, Scrubbers, and Mechanical Picklers
WRITE FOR FREE CATALOGS

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY
3700 OAKWOOD AVENUE . . . . YOUNGSTOWN 9, OHIO

Norton Company Starts Work in New Plant

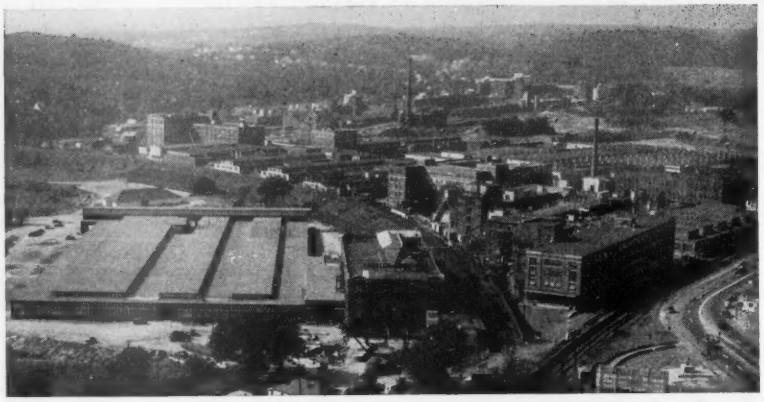
THE Norton Company, Worcester, Massachusetts, dedicated a new $4,300,000 manufacturing plant in a private ceremony on August 30th. Over 602 feet long and 320 feet wide, containing approximately 5 acres of manufacturing space on one floor, the building is the largest in the world for the manufacture of grinding wheels.

* * *

THE building was especially designed and constructed to house a radically improved process of grinding wheel manufacture — a process which enables wheels to be made to new standards of precision in dimensions and balance with a degree of uniformity previously considered impossible in a vitrified product.

* * *

GEORGE N. Jeppson, chairman of the board of The Norton Company, who started this development and participated in the inventions involved, delivered the opening dedicatory address on the subject of "A Vision Becomes a Reality". He then turned the new plant over to **Milton P. Higgins,** president. Mr. Higgins gave the dedication address.



Airplane View — New Norton Grinding Wheel Building in left foreground and rest of plant in background.

* * *

IN turning over the new plant to Mr. Higgins, Mr. Jeppson also presented him with the ten millionth grinding wheel made by the new process. This process was originally envisioned by Mr. Jeppson as a method which would not only make grinding wheels faster, but better. His ideas were turned over to Norton development engineers who declared Mr. Jeppson's suggestions basically sound when they

Sjogren

A STURDY Wedge Grip built to standard specifications and to withstand harder-than-average useage. Replacement jaws fit perfectly. The S & S rugged, pyramidal tooth design is reenforced for strength and to reduce slippage. All teeth are specially cut and with a hardness for long life on high carbon wires. Jaws for nearly any type puller used in the wire industry are available from stock.

WIRE PULLERS • WEDGE GRIPS • JAWS FOR ALL MAKES OF PULLERS AND TESTING MACHINES • CAGE ROLLERS • SWAGING HAMMERS • POINTING DIES • WIRE SPOOLERS

SJOGREN TOOL AND MACHINE CO., INC.
Tools for The Wire Industries
14 SWORD STREET, AUBURN, MASSACHUSETTS

were able to produce grinding wheels experimentally in hours instead of days and with a degree of uniformity that previously had been considered impossible.

* * *

TOTAL cost of Plant 7 was estimated by company officials at $4,300,000, of which $1,800,000 was for the building alone and $2,500,000 for equipment. The building lends itself to straight line production and parallel manufacturing lines have been set up throughout the 602 foot length of the new plant. Abrasive grain and bond are brought into one end of the building and the various production steps take place in quick succession. A radically new feature of each production line is the continuous electric firing of grinding wheels in specially designed kilns. Modern conveying equipment has been extensively used to hold handling to a minimum. The building, the largest in the world for producing grinding wheels, not only houses the production equipment but also a cafeteria, hospital, offices for the supervisory personnel, and modern lockers and washrooms.

Lindberg To Have Heat Treating Plant

A new custom heat treating plant now under construction in St. Louis, Missouri will be opened by **Lindberg Steel Treating Company** on or about November 1, according to an announcement by L. A. Lindberg, president of the company.

* * *

THE new building located at 650 E. Taylor Ave. will have 6000 square feet of floor space and will house 14 new heat treating furnaces including 3 furnaces for toolroom tempering, 2 pit type for production tempering and aluminum and nonferrous heat treating, 1 for production nitriding, 2 for tool room hardening, 1 for high speed hardening, 2 for production hardening and 3 pot type for hardening in molten salts or lead. New equipment for induction hardening and flame hardening is also being installed. Modern quenching equipment will include units for quenching in oil, brine, or molten salt. Protective atmosphere for hardening furnaces will be supplied by a 1500 C. F. H. endothermic type atmosphere generator. A metallurgical control laboratory will be located in the office section of the building.

* * *

THIS is the second branch plant established by Lindberg in the last two years. The first was opened early in 1947 at Rochester, New York. The main plant is located in Chicago.

Cowles Detergent Company Announces Change In Name

AT a special meeting held in Cleveland, Ohio on August 16th, the stockholders of **The Cowles Detergent Company** approved a resolution changing the firm's name to Cowles Chemical Company.

WILLEY'S SIZING, EXTRUSION AND WIRE DRAWING DIES

Sales Engineers in Principal Cities.

They are made from a specially developed grade of Tungsten Carbide having those characteristics needed for dies—freedom from porosity, great abrasion resistance and the ability to take a polish equal to that of diamonds.

FOUR CLASSIFICATIONS OF WILLEY'S DIES

A. Blank and rough cored nibs.

B. Rough cored dies (cased).

C. Semi-finished, rough drilled dies (cased).

D. Finished dies, ready for use.

WRITE FOR NEW CATALOG 30

Gives full information on Willey's Dies in addition to other standard tools.

Standard Sizes from .325 to 4.000. Specia Sizes and Shapes Made to Order.

WILLEY'S CARBIDE TOOL CO.

SOLE MAKERS OF WILLEY'S METAL

1342 W. Vernor Highway Detroit 1, Michigan

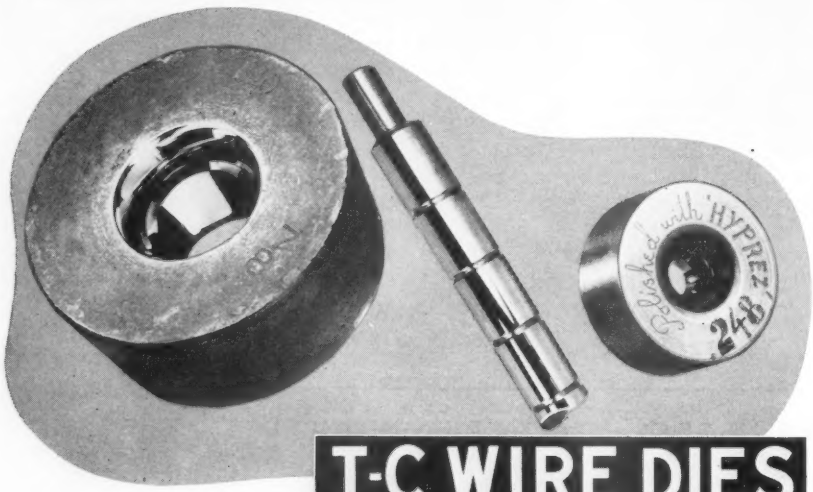
IN making the announcement, **Mr. Edwin Cowles**, President of the Company, stated: "A change in the name of the Company seemed advisable because the business of the Company is becoming increasingly diversified and is no longer restricted to detergents, which are a specific class of chemicals. Since the Company is largely engaged in manufacturing and selling a varied line of chemicals, it seems proper to change the name to Cowles Chemical Company."

* * *

FOUNDED in 1885, the Company has long been active in the manufacture of industrial chemicals and detergent silicates as well as specialized detergents for the laundry and metal cleaning industries. The change in the Company's name is indicative of its continued further expansion in other industrial chemical fields.

* * *

NO change in ownership, management or policy is involved in the change of name.



T-C WIRE DIES

Quickly and Economically
Finished to Perfection with

HYPREZ DIAMOND COMPOUNDS

Hyprez produces a perfect, lasting polish on Tungsten-carbide Dies, Tools, and Wear Parts — quickly, economically.

Fast cutting, clean, virgin diamond powders, very accurately graded, are uniformly suspended in a patented compound base; which will not fly off tool or die; and which remains stable and uniform at all normal temperatures.

Hyprez is a scientifically balanced product to match your finishing skill — available in 24 engineered standards. We will gladly recommend the proper grade for a complete and perfect job.

Supplied in fully color-identified dust-proof cartridges and sturdy applicator or in substantial container for conventional use, if preferred.

HYPREZ DIVISION
ENGIS EQUIPMENT COMPANY
431 SOUTH DEARBORN STREET • CHICAGO 5, ILLINOIS, U. S. A.

Kelly Award To Be Made At AISE Convention

THE Kelly Award was again the feature trophy of the **Iron and Steel Convention** held September 28th through October 1st in the Cleveland Public Auditorium. Made annually by the Association of Iron and Steel Engineers, the award is presented to the authors of the three technical papers judged to be of greatest value in the advancement of engineering or operating practice in the iron and steel industry. The award carries with it cash prizes of $300, $200 and $100, and is open to anyone directly employed in the iron and steel industry, regardless of membership in the asscciation.

New Plant for Bethlehem

THE supply situation in the fastener field may be eased slightly with the opening of a new nut and bolt plant in Seattle by **Bethlehem Pacific Coast Steel Corp.** The Seattle unit, costing $500,000, will produce approximately 10,000 tons annually and will up Bethlehem Pacific's total bolt and nut output to 30,000 tons a year.

* * *

PRODUCTION is integrated from steelmaking to packaging of bolt and nut products. Equipment installed for the new unit includes heading, threading, nut-making and tapping machinery. Production line technique in producing hot-forged and cold formed bolt and nut items is followed. Die and moving parts for the machines are made in the new plant's machine shop.

* * *

FACILITIES have been designed for production of several specialty items. These include silo rods, wooden conduit bands, foundation bolts, special agricultural machinery bolts, salmon trap staples, railroad specialties and plywood bolts. Bethlehem Pacific also manufactures bolts and nuts at Los Angeles and San Francisco.

* * *

Transformer With Expansion Tank

THE Eisler Engineering Co., Inc., Newark, New Jersey, specializing over 27 years in the manufacture of all types of Transformers up to 400 KVA and 15,000 volts, just put on the market an oil-insulated, self-cooled type transformer, shown in the accompanying illustration, provided with an expansion tank, the purpose of which is to maintain the transformer oil as long as possible in good condition.

* * *

IN general, this transformer is built by mounting one tank directly on the cover of one standard O.I.S.C. transformer of the proper size by means of structural steel supports. This expansion tank, also known as "oil conservator", is connected with the main tank of the transformer, about half filled with the transformer oil, and provided with a gauge to indicate the oil-level, a ventilating breather and necessary filler and clean-out holes (not visible in the view).

AIR residues, vapor and condensed moisture are collected in the expansion tank, thus leaving the insulating and cooling properties of the transformer oil, circulating through the coil windings, undamaged. These impurities can periodically be removed from the expansion tank.

Eisler Transformer with Expansion Tank. *

* * *

The bent steel pipe bolted on the transformer cover and connected with the transformer oil room is normally tightly shut by a pressure relief diaphragm. It is a safety device releasing the undue pressure inside the transformer through the suddenly burst diaphragm in case of any accidental occurrence. The illustrated transformer is a 100 KVA, three-phase unit of special design and was recently supplied for an important hospital installation.

SEND IN
YOUR ORDER NOW
for the
1948 WIRE BUYERS GUIDE

QUALITY WIRE FOR YOUR PRODUCT

The appearance, production and cost of your product is greatly influenced by the quality of wire used. Let Laclede engineers and metallurgists aid you in developing wire specifications to fit your exact need.

Wire for All Needs
All Grades and Finishes
Bright or Black Annealed
High Carbon Spring
Low Carbon Bright Basic
Tinned, Galvanized
Copper Coated — Liquor Finishes
Sizes: .007 –.50 Dia.
Coils, Spools, or Cut Lengths

LACLEDE STEEL COMPANY
SAINT LOUIS, MISSOURI

Machinery for
SPOOLING AND COILING WIRE

We have helped improve efficiency of many companies through use of our modern designs. Write us your problems and our representative will be glad to try to help you.

Recently we completed the design and construction of a semi-automatic coiler (the wire is fed continuously to alternating heads) for use on soft wire. Ask us about it.

●

BOYD - FIDELITY SPOOLERS

CHARLES P. BOYD CORPORATION

1434-38 Callowhill St. Philadelphia 30, Pa.

THE DRIVE FOR SCRAP— DON'T LET IT LAG

Although the wire industry's drive for scrap has borne good fruit, it is still important that the pressure be kept on by wire mills and wire product fabricators.

Scrap should be sorted and shipped with promptness and regularity to facilitate both its availability and ready utility. The continued cooperation of everyone in the industry is earnestly urged.

The threat of war hangs over us like the sword of Damocles; one of the best ways to avoid it is to increase our strength through higher steel production — to which scrap contributes.

This request to provide scrap for the making of steel applies to small as well as large concerns, for the flow of scrap from the many small shops, in the aggregate, can produce large results.

THE WIRE ASSOCIATION

Richard E. Brown, Executive Secretary

300 MAIN STREET STAMFORD, CONN.

Wire Drawing Reseach in the British Iron and Steel Research Association

(*Continued from page* 907)

it is hoped that this outline of the work already under way will be of some interest to American workers in this field.

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* * *

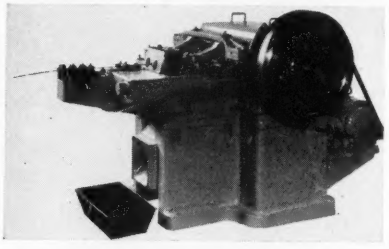
Black Introduces New Nail Making Machine

MANY of the "Who's Who" in the nail making business were in Cleveland the week of August 16th to witness a working demonstration of the new Model DA nail machine designed and manufactured by **Black Industries,** 1400 East 222nd Street, Cleveland, Ohio.

* * *

THIS newest nail machine is a heavy duty, all steel construction unit, so designed that noise and vibration are reduced to a minimum. Cams, crankshaft and feed mechanism are pressure lubricated and the circular cross-head floats on a film of oil. The heat-treated alloy steel crankshaft is counterbalanced, fully enclosed and supported at four points by steel-backed cadmium silver bearings designed for an estimated life of 30,000 hours of hard service.

THIS machine has a delayed feed action so that the gripper does not pinch until the wire is fully stopped. The length of feed covering the full range of sizes from ½" to 2¾" nails is adjustable while the machine is in operation. No. 10 to 14 gauge wire may be used. The complete unit, with motor, weighs 5110 pounds, with every part designed to give high speed production with lower maintenance



Black's new nail making machine. * *

and repair costs. During the demonstration a speed of 425 nails per minute was maintained.

* * *

IT is operated by a 5 horsepower motor through V-belts to a safety shielded flywheel.

New Plating Equipment Booklet by Meaker

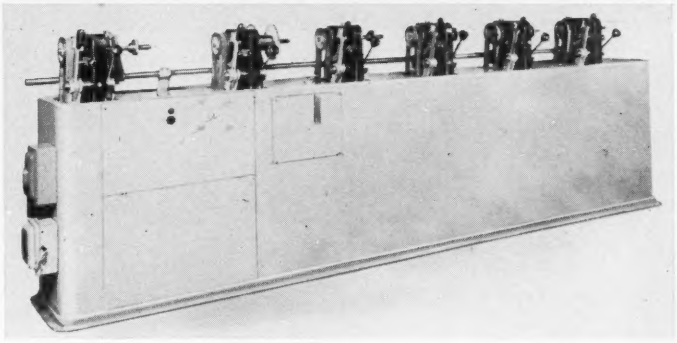
THE **Meaker Company** 1629-41 South 55 Avenue, Chicago 50, Illinois has just issued a 36-page booklet, Number 148. This booklet describes the Meaker design of automatic, semi-automatic, and special machines for plating and other sequence processing. Included are many illustrations showing the different type machines under diversified operating conditions. A section of the booklet is devoted to plating data tables.

* * *

A copy of this booklet may be had by addressing the Meaker Company.

New Die Catalog

THE **Carboloy Company** has issued a new catalog giving specifications and prices on wire drawing dies, die machinery, mandrels, nibs and so forth. If you have not received your copy, please write them for No. D-126 at Detroit, 32, Michigan.



NO. 1900K MULTIPLE SPINDLE SPOOLER

This spooler is outstanding for its many unusual and desirable features. Takes spools up to 16" flange diameter. Enclosed type, with mechanism readily accessible from rear side. Spindles mounted on ball bearings and each may be stopped or started individually. Uses Worthington All-Speed Drive unit.

All Emory Spoolers supplied standard or equipped to meet customers' special specifications.

On Spooling problems, consult

ROBERT J. EMORY COMPANY

31 EAST RUNYON STREET NEWARK 5, NEW JERSEY

COVERING The Wire and Wire Products Industry IN CANADA

The A. R. Williams Machinery Company, Limited, with offices in seven principal Canadian cities, is proud to represent for the Dominion, the following well-known firms:

THE TORRINGTON MANUFACTURING COMPANY
Torrington, Conn.

JAMES L. ENTWISTLE CO.
Pawtucket, R. I.

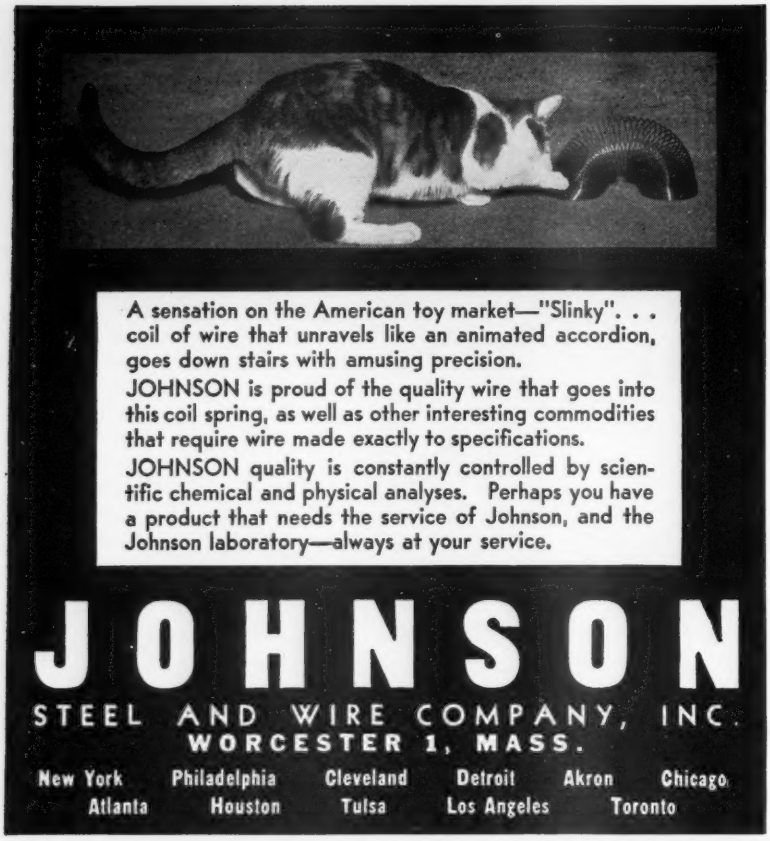
FIDELITY MACHINE COMPANY, INC.
Philadelphia, Pa.

CARBOLOY DIVISION,
CANADIAN GENERAL ELECTRIC COMPANY LIMITED
Toronto, Canada

IF IT'S MACHINERY WRITE WILLIAMS CANADA'S LEADING MACHINERY HOUSE

THE A.R.WILLIAMS MACHINERY COMPANY LIMITED

HALIFAX MONTREAL OTTAWA TORONTO WINNIPEG CALGARY VANCOUVER VICTORIA


A sensation on the American toy market—"Slinky"... coil of wire that unravels like an animated accordion, goes down stairs with amusing precision.
JOHNSON is proud of the quality wire that goes into this coil spring, as well as other interesting commodities that require wire made exactly to specifications.
JOHNSON quality is constantly controlled by scientific chemical and physical analyses. Perhaps you have a product that needs the service of Johnson, and the Johnson laboratory—always at your service.
JOHNSON
STEEL AND WIRE COMPANY, INC.
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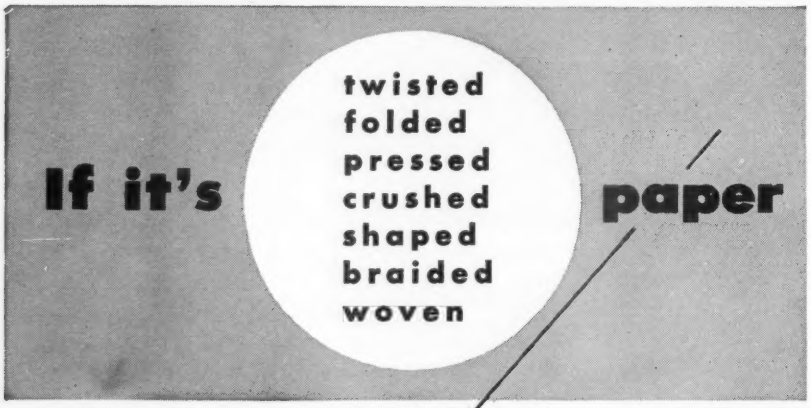
New York Philadelphia Cleveland Detroit Akron Chicago
Atlanta Houston Tulsa Los Angeles Toronto



TWITCHELL makes it

fine, treated yarns wound 4 ends parallel for high-speed wrapping by new Abbo-sealed process will be available soon.

waxed cable-filler for 2- and 3-wire non-metallic sheath cable and ship-board cable.

wire-rope cores

braiding and wrapping yarns for electrical cable.

E. W. TWITCHELL INC.
Third & Somerset Streets,
Philadelphia 33, Pa.

New Catalog on Die-Less Duplicating

A new edition of the 40 page Di-Acro catalog has been published by **O'Neil-Irwin Manufacturing Company.**

* * *

A number of new machines brought out in the past year; including larger heavy duty benders and shears, are included in the new book.

* * *

ONE of the interesting features mentioned on page 40 of the book is a newly instituted Di-Acro Engineering Service, through which they offer to conduct experiments and issue reports on the most economical manner in which die-less duplicating can be performed. Our readers are invited to submit their forming problems to them.

* * *

COPIES of the catalog are available gratis to anyone who would like information on the subject of die-less duplicating. Please address the company at 385 Eighth Avenue, Lake City, Minnesota.

* * *

P. J. Jensen New Manager of Carboloy's Michigan District

APPOINTMENT of **P. J. Jensen**, formerly Executive Engineer in the Engineering and Research Department at Carboloy Company, Inc., Detroit, to the position of Manager of the Michigan District for Carboloy with headquarters in Detroit, has been announced by **K. R. Beardslee**, Vice President and Marketing Manager at Carboloy. Jensen succeeds **M. E. Knoll** who is retiring after 19 years service with Carboloy, 18 of which he spent as Manager of the Michigan District.

"There's Always Another Use For Productimeters"

INGENIOUS plant engineers are constantly finding new applications for Productimeter Counting and Measuring devices. Obtaining and counting exact lengths of wire presented a problem to one manufacturing plant, but it was solved simply and easily.

* * *

THE unit illustrated here consists of a solenoid operated wire cutter, a Micro Switch, and a Model

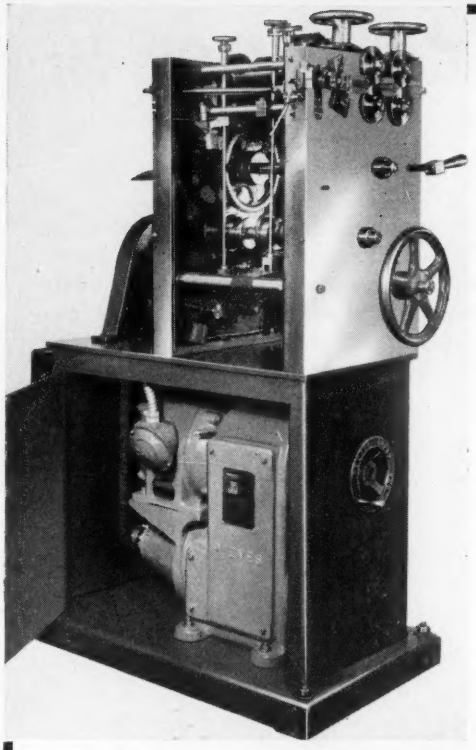
Model 5-D-1 Stroke Productimeter. * *

5-D-1 Stroke Productimeter. The sensitive Micro Switch can be moved along the ruled bench to secure any desired length of wire. The operator pulls the wire from a reel until the end touches the button of the actuator that closes the switch. The solenoid instantly operates the cutter and at the same time strokes the counter. That's all there is to getting even lengths of wire and getting the exact count of the pieces cut... automatically, speedily and with production line volume.

* * *

PRODUCTIMETERS give accurate count and measurement in the manufacture and processing of many types of products. Bulletin #100, showing the wide range of available models, will be sent on request. **Durant Manufacturing Company,** 1921 N. Buffum Street, Milwaukee 1, Wis.

* * *



SAMUEL SPRING COILING MACHINES

NOTED FOR:

HIGH SPEED
ACCURATE WORK
EASY ADJUSTMENTS
HIGH PRODUCTION ECONOMY
TROUBLE-FREE PERFORMANCE
HIGHEST GRADE MATERIALS
FINEST WORKMANSHIP

Designers, Builders, Engineers Since 1933 Of Automatic Wire-Working Machinery.

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NILSON

AUTOMATIC PRESS and FOUR SLIDE MACHINE

FOR SWAGING, STAMPING, PIERCING, BLANKING, FORMING OF COILED METAL

We also build machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc., and Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses.

For Complete Details Address —

THE A. H. NILSON MACHINE CO.
BRIDGEPORT, CONN., U. S. A.

THE CRUM CALCULATOR for Wire Drafting

Provides answers simply and accurately for a given mathematical wire drafting problem. One setting shows number of holes, percentage of draft per hole, total reduction in area and intermediate die sizes to be used. Universality: Because of the circular scale there are neither upper nor lower limits on the diameters that the calculator can be used for.

The Crum calculator is designed especially for wire drawing jobs involving eight or fewer drafts. Problems involving a greater number of drafts can be solved, however, with extra manipulation. For instance, if it is desired to set up a multi-draft machine to draw .0095 inch diameter wire from .0625 inch stock in sixteen drafts, the intermediate die sizes can be determined by the calculator.

HOW TO ORDER

The price is $5.00 each. A discount of 10% on ten or more. Send check or purchase order to

WIRE & WIRE PRODUCTS

300 MAIN STREET **STAMFORD, CONN.**

For Treating Bars, Rods, Wire, Strip, Springs

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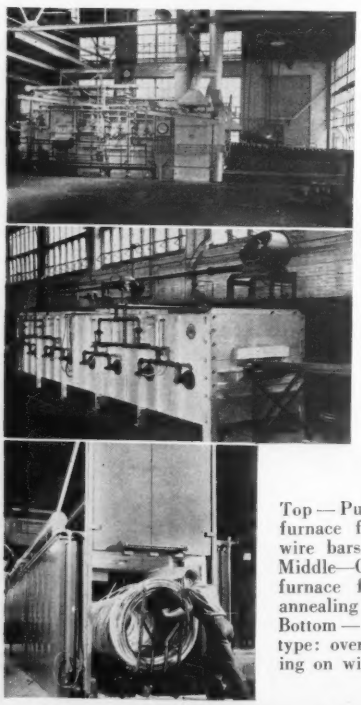
ROCKWELL FURNACES OVENS • BAKERS SPECIAL MACHINERY



Top — Pusher type furnace for copper wire bars.
Middle—Continuous furnace for bright annealing wire.
Bottom — Tunnel type: oven for baking on wire.

- Rockwell batch or continuous, direct, muffle or radiant tube furnaces of all types for metal heat treating.
- Gehnrich ovens, batch or conveyor types, for aging, normalizing, drawing, baking finishes and protective coatings, and lime on wire rods.
- Coil winding machines, reels and spools; pickling, brushing, cleaning, washing, finishing, drying and handling equipment; special fabrications.

We also design non-ferrous rod mills.

Write for Bulletins

W. S. ROCKWELL COMPANY
242 ELIOT STREET • FAIRFIELD, CONN.

Sam Tour Appoints Howard Kapner

THE appointment of **Howard Kapner** to be in charge of the new Glass Section of the laboratories of **Sam Tour & Co., Inc.** engineers, metallurgists, consultants, is announced by Mr. Tour.

* * *

MR. Kapner, who has made a study and hobby of glass technology for eight years and who has been in the laboratories of Sam Tour & Co., Inc. for the last year, will handle all testing, laboratory and research work on glass.

* * *

LOCATED in the company's building at 44 Trinity Place, New York City, Mr. Kapner's office and laboratory equipment will occupy space recently made available.

* * *

Du Pont Patents Available for Licensing

THE Du Pont Company has announced that it is listing a number of its patents on the Patent Register of the U. S. Patent Office as available for licensing.

* * *

THE company said 4260 patents which are about two-thirds of the patents the company owns, and which cover many phases of its diversified operations, have been submitted. The first official listing of Du Pont patents is expected to appear in an early issue of the Patent Office Gazette.

* * *

STUDY of the company's patents will be continued to determine what additional listings may be made from time to time, and patents not included in the present registration are not necessarily withheld from consideration for licensing. The present list was compiled only from patents granted since January 1, 1933, as those with only a short remaining life were not considered. The life of a patent is 17 years.

* * *

THE Public Register of Patents Available for Licensing has been in effect since June, 1945. Du Pont pointed out that registration marks no particular change in its policy as, over the years, the company

has licensed many of its patents. It noted that registration appears to be a convenient and practical method of bringing patents to the attention of industry.

National Machinery Is Now Producing New Cold Nut Former

COLD nut formers said to be capable of producing "a greater variety of high quality hex nut blanks than is possible with other machines of this type," are now being manufactured in volume by **The National Machinery Company,** Tiffin, Ohio.

* * *

STANDARD single and double chamfered nuts, washer faced nuts, castellated nuts, hug lock nuts, marsden lock nuts, and jam nuts have all been produced on these machines, the company says. The announcement adds:

* * *

"THE machines are built in 5/16", 3/8", 1/2", 5/8", 3/4", and 1" sizes. Outputs range from 100 nuts a minute on the 5/16" size to 40 a minute on the 1" size."

* * *

"SIMILAR to a transfer header in design, the cold nut former utilizes a new principle of operation. Only a minimum of cold forging is done on the blanks until the later operations.

* * *

"HENCE, internal stresses caused by early work hardening are avoided, and the finished blanks have typical forging strength and toughness. Minimum working in the early stages is possible because the machines use larger diameter wire or rods than that used in other machines and a shorter length is upset.

New Portable Self-Contained Dust Collector

A new, low cost, highly portable self-contained dust collector for collecting dust from small wheel

FOR SALE

50 - 60% Under Mill Prices

50,000 lbs. Size .011 High Carbon Galv. Steel Wire
150,000 lbs. Size .013 High Carbon Galv. Steel Wire
on 10 lb. Spools

100,000 lbs. 7-Wire Strand, consisting of
6 size .0095 Low Carbon Galv. Steel Wire
1 size .010 Tinned Copper Wire
on Spools and Reels
3,500 lbs. Size .00785 Music Wire in coils, paper wrapped and oiled

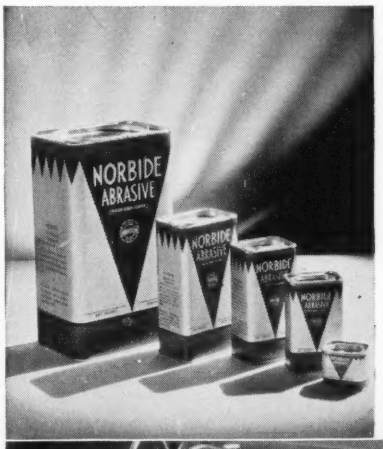
2 Syncro Stranding Machines - 7 Wire
complete with take-ups — 5 h.p. motor; 220/440/3/60 A.C.
Accommodates up to 6½" x 4" Bobbin.

4 Fidelity Spooling Machines
Single End Screw Type —
w/o motor — 6½" x 3½" x ⅝" bobbin

50 Double Reel Let - Off Dolly Trucks
for DR-5 reels
Steel Frames 4 ft. 3 in. Long; 2 ft. 5 in. Wide
350 Metal Spools, Copper Clad 4" x 5" x ½"

Samples, Prices & Details On Request

PLYMOUTH WIRE & CABLE CO.
340 Main Street **Worcester, Mass.**
Tel.: WOrcester 6-8027



NORBIDE ABRASIVE
For Cemented Carbide Dies

NORBIDE Abrasive is successfully used for cutting and semi-finishing cemented carbide wire drawing dies. This abrasive is second only to diamond powder in hardness and is 150 times less expensive. Sizes 220 and 240 for ripping; 320F for semi-polishing; 500 to 800 for final finishing.

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

Harper

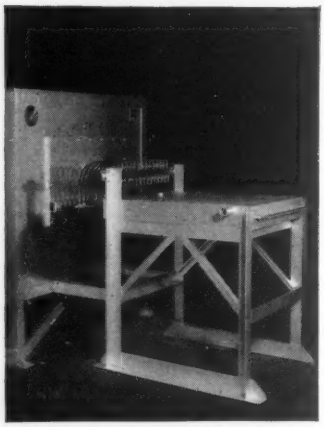
Electric Furnaces

for

BRIGHT ANNEALING

STAINLESS

STEEL WIRE



The above photograph pictures a Harper Furnace specially designed for the continuous bright annealing of 30 strands of steel wire.

The manifold shown distributes hydrogen to 30 tubes which extend through the furnace and through the water-cooled chamber. This furnace is typical of many standard furnaces designed and built by Harper Engineers for the metal working industries.

We will be glad to send you literature on our standard furnaces or work with you on special designs to meet your exact requirements.

HARPER

ELECTRIC FURNACE CORP.

1444 Buffalo Avenue, Niagara Falls, N. Y.

Representatives in all principal cities.

grinding and sanding and lint from buffing and polishing operations is added to its line of industrial dust collectors by **Aget-Detroit** Company, 376 Main at Washington Streets, Ann Arbor, Michigan.

* * *

DESIGNED for continuous dust collecting work on production operations, the Model 335 DUST-KOP is sufficiently compact (12″ x 14″ x 18″ high) to permit it to be installed on or under a bench while its light weight (43 lbs.) is ideal where portability is essential.

* * *

A rating of 320 cfm at 1½″ water lift on 3″ inlet is developed by a continuous duty, 3600 rpm. ⅓ hp. motor, direct driving a self-clearing paddle wheel fan of a special design which has been used extensively on other, larger model DUSTKOP dust collectors. This rating is sufficient, it is said, for handling dust from small wheel buffers, wire brushes, flexible shaft grinders, etc.

* * *

A selection of inlet connections are optional, as follows: single 3″, double 3″, single 4″ and single 5″. All inlets are manufactured to make a slip fit with flexible metal hose or standard sheet metal pipe, thereby facilitating installation by eliminating any costly duct work.

* * *

Creep Testing Machine

A new motor-driven, screw-type creep testing machine of 20,000 lb. capacity, designed for short-time, creep-rupture tests at high temperatures, with a minimum of operator attention is announced by **The Baldwin Locomotive Works**, Testing Equipment Department, Philadelphia 42. The machine automatically maintains constant loads up to 100,000 lb. per sq. in. on standard 0.505-in. diameter specimens while temperatures are held constant up to 2200 deg. F. Tests of this type may run for 10 to 400 hours.

* * *

A feature of the machine is a flat 10-in. chart recorder panel in front, with which no extensometer is required and no strain readings

NOTICE TO SUBSCRIBERS

WIRE & WIRE PRODUCTS

BUYERS GUIDE and Year-Book

of the Wire Association

The 1948 Edition of this useful diretorcy may be obtained by subscribers at 40% discount from the list price of $5.00 per copy. So when ordering your subscription to WIRE and WIRE PRODUCTS, if you want a copy of the BUYERS GUIDE, please enclose $3.00, or send the order and ask us ot bill you.

Members of the WIRE ASSOCIATION will continue to receive a copy of the BUYERS GUIDE as part of the service extended to them, and the cost as included in the dues.

To all others the price remains as heretofore $5.00 per copy.

THE BUYERS GUIDE is a complete directory of all kinds of wire and wire products manufactured in the country, together with listings of all machinery, equipment, supplies and service used by the Wire Industry.

It is an invaluable source of information on everything of interest to wire men. Be sure to order your copy early to be certain of getting one, as the edition is limited. Published in Spring annually . . . Only $3.00 to subscribers.

WIRE & WIRE PRODUCTS

300 MAIN ST., STAMFORD, CONN.

need be made. This relieves the operator of giving much time and attention throughout the test and avoids drawing curves manually from recorded data. The elongation versus time curve is automatically and accurately drawn on the chart from the start of the test until rupture occurs. It assures much greater accuracy at the final point of the curve, or for plastic strain at rupture, than has hitherto been possible by the conventional practice of measuring after rupture by fitting the two broken ends of the specimen together.

* * *

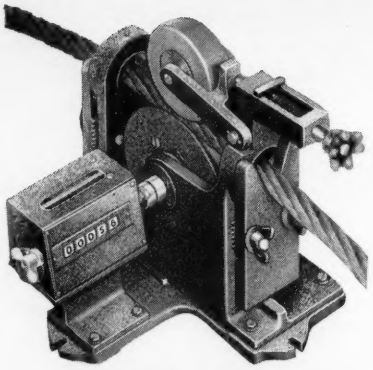
THE recorder panel is driven vertically with the elongation of the specimen by the driving mechanism of the loading screw. The recorder pen is driven horizontally by a clock mechanism. Elongation is also indicated by a revolution counter which can be read directly in thousandths of an inch. It is operated by direct flexible shaft connection with the screw jack drive shaft. Change gears in the elongation drive to the recorder give 1, 2 and 4 percent elongations per inch.

* * *

THE specimen is loaded below through gearing by means of a large, electric-motor-driven screw having a stroke of approximately 4 in. The top end of the specimen is supported by a stiff, heavy spring block on which the constant load is maintained by keeping a constant deflection. The deflection of the spring block is measured by a dial gage with an electrical contact. The electrical contact controls the motor that drives the screw. Thus, a constant deflection is maintained in the spring block and a constant load is applied on the specimen during its elongation. When the specimen ruptures, the control circuit (of which the specimen is a part) is broken and both motor and clock are stopped.

* * *

THE new machine can also be adapted readily to short-time tensile tests, constant strain-rate tests, or relaxation tests. The machine weighs approximately 1200 lb., is 7 ft. high, and requires a 16-in. by 30-in. floor area.



Model L-20—double worm drive for smooth, continuous operation—subtracts when reversed.

Mile-a-Minute

COUNTING

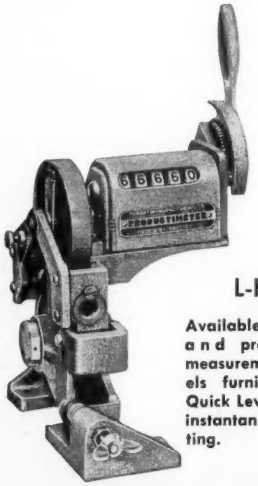
The Productimeter illustrated above will measure wire up to 1½" diameter at speeds of 5000 feet per minute — nearly a mile a minute. Exclusive features assure accuracy and long life for these precision instruments. Speed and assured accuracy are absolutely necessary to prevent losses in wire manufacturing or handling. Also models available to measure wire down to .010 in.

Send for Catalog No. 40.

DURANT MFG. COMPANY

1918 N. Buffum Street, Milwaukee 1, Wis. — 118 Orange Street, Providence 3, R. I.

Representatives in Principal Cities

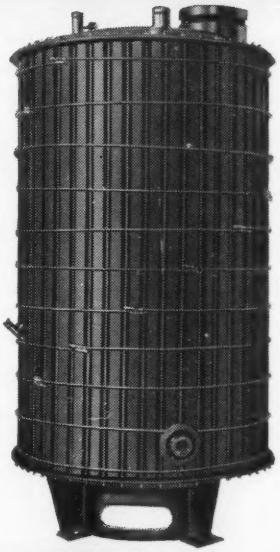


Model L-HDW-16-Q

Available for direct and predetermined measurement. Models furnished with Quick Lever Reset for instantaneous resetting.

PRODUCTIMETERS SINCE 1879 — Speedometers OF INDUSTRY

Lick CORROSION PROBLEMS



THIS POSITIVE, ECONOMICAL WAY!

If you've ever had equipment losses due to corrosion . . . if you've ever wanted a sure, economical way to solve corrosion problems . . . investigate HAVEG.

Here is a molded structural material that assures complete acid, alkali and solvent resistance *throughout its entire mass* . . . it is not just a lining or coating!

HAVEG equipment lasts longer . . . costs less. Its strength, toughness, and durability make it ideal for tanks, towers, coolers, piping, valves and similar applications. For *real* help in your fight against costly corrosion, investigate HAVEG, now.

Bulletin F-5 gives complete design, engineering and application data. Write for it today.

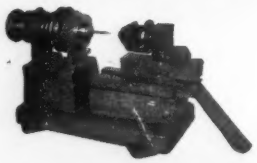
HA-5-48

HAVEG CORPORATION
NEWARK 47, DELAWARE

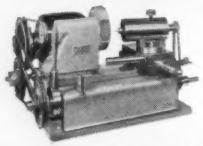
CHICAGO 11 · CLEVELAND 14 · HARTFORD · HOUSTON 6 · DETROIT 11 · LOS ANGELES 13 · SEATTLE

NEW
ROOS
MACHINES
for the
DIE ROOM

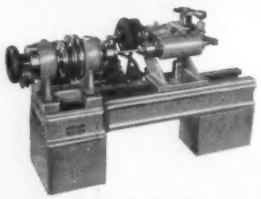
- ROOS PIN MAKER



- ROOS PRECISION PIN GRINDER



- ROOS AUTOMATIC POLISHERS



A COMPLETE LINE OF LAPPING MACHINES, DRILLERS AND POLISHERS TO SPEED UP PRODUCTION IN YOUR

DIE ROOM

WAKE IT UP

with **ROOS**
DIE FINISHING MACHINERY
ROOS TOOL & MFG. COMPANY
Plant and Shipping Point
17 Grove Street, Montclair, N. J.
Sales Office
49 Bloomfield Avenue, Newark 4, N. J.

Announcing Boston Office

THE Durant Manufacturing Company has established at 1105 Commonwealth Avenue, Boston 15, Mass., an office to better serve customers in the Boston area, as well as in Maine and New Hampshire. It will be under the management of James K. McGinley who has had several years' association with the Home Office in Milwaukee.

* * *

MR. McGinley is thoroughly familiar with Productimeters and their application in the varied industrial fields, and can render complete field service on your counting and measuring requirements.

* * *

Bulletin Describes New Salt Bath Furnace

A new submerged electrode furnace produced by the **Ajax Electric Company, Inc.**, Philadelphia, Pa., is described in their Bulletin No. 122. The furnace is designed for work of unusual length and can be used at temperatures ranging from 300 to 2400 degrees F. to combine rapid, uniform heating and simplicity of operation.

* * *

COPIES of the Bulletin may be secured by writing the Company.

* * *

Revised Catalog on Position-Adjusting Control Issued by Leeds & Northrup

SOME of the many ways that modern automatic controls are helping industrial users to improve operating efficiency are outlined in a newly-revised, 40-page catalog, "L & N Electric Control, Position-Adjusting Type", just issued by the **Leeds & Northrup Company.** Applicable to practically any process which can be controlled by moving a valve, vane or damper, this electrically-actuated equipment is regulating temperature, pH, electrolytic conductivity and gas analysis in steel mills, chemical plants, paper mills, and hundreds of other industries

LET

M & T

STANNOCHLOR
or
STANNOUS SULPHATE
solve your tinning problems

One of these two M & T chemicals will meet all your liquor finishing or immersion plating requirements . . . whether for acid or alkaline . . . white or bronze finish baths.

STANNOCHLOR and STANNOUS SULPHATE are stable . . . will not deteriorate with age in summer or in winter. Their use makes it possible to keep a stock on hand at all times . . . permits purchasing in large quantities for economy.

And, because they contain no water of crystallization, STANNOCHLOR and STANNOUS SULPHATE go further pound for pound.

Write for more complete information.

METAL & THERMIT CORPORATION
120 Broadway • New York 5, N.Y.

IN addition to the well-known Micromax instruments, the publication also lists the Speedomax line of Controllers for applications where unusual sensitivity and speed of response are required.

* * *

TO receive a copy, just write to Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 44, Pa., and ask for Catalog

New Line Manual Starting Switches For Fractional-HP Motors

A new line of manual starting switches for use with fractional-hp motors has been announced by **General Electric's Control Division.** The new switches are furnished in five different types: with general-purpose enclosure; without enclosure; a combination unit and selector switch; with cast iron enclosure for wet locations, and a similar type for dusty or hazardous locations. The switches are desirable for use with fractional-hp motors driving blowers, pumps, ventilating systems, small machine tools, and a wide variety of similar applications.

* * *

AN important feature of all five types is a molded base of moisture-resisting insulating material which mounts and encloses the mechanism and contacts. This particular construction serves not only to protect the operating parts from dust and physical contact, but to direct the heat concentration to the sturdy bimetallic tripping device, thus assuring that the action of the overload is quick and positive. Another feature is the action of the switch handle, which moves to the OFF position on overload, thus giving positive indication that the power is shut off. The wheel-type movable contact cleans as it rolls against the stationary contacts, and, in addition, recedes into a recess in the base, thus effectively snuffing the arc.

* * *

ALL parts of these switches are rust-resisting, readily accessible wiring terminals on the tops of the units facilitate easy wiring, and the screws for fastening the molded back cover are attached to the cover to prevent their being lost.

CEILCOTE CORROSION PROOFING

Including Acid & Alkali Proof Linings
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When installed in the proper combination under complete contract or our supervision will give years of maintenance free operation.

BACKED BY 25 YEARS EXPERIENCE

We will be pleased to submit recommendations and estimates on pickling, storage, and neutralizing tanks, as well as fume duct linings, acid pits, floors, sewers, and sumps at no obligation.

Write for further information and complete catalog.

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THE CEILCOTE COMPANY
Corrosion Proof
Materials - Construction - Supervision
ROCKEFELLER BUILDING CLEVELAND 13, OHIO

Hair Pin Hooks
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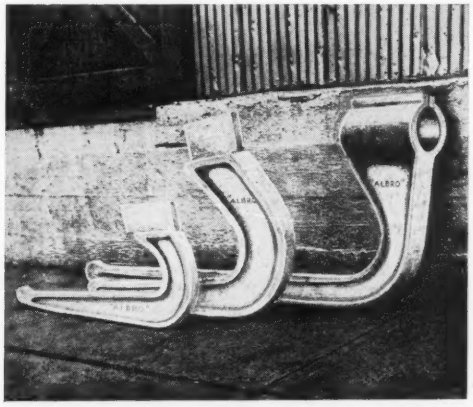
for Pickling Coils



We make them in all sizes of our "Albro" Acid Resisting Metal

The same metal as our time-proven "Albro" Die Cast Acid Resisting Chain.

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BRONZE DIE CASTING COMPANY

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For Pickling—Chains—Hooks, Clevices, Bolts, Crates.

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STEAM
Jets

E-4 Jet for Sheet Pickler.

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Insert; Flanged Section.

• Reports show increases in tonnage pickled from 20% to 40%. Savings in acid consumption also reported.

Our complete series of jets have been designed to give thorough heat and agitation to any or all parts of the pickling vat. Write Dept. J for free Bulletin No. 43.

PICKLE TANKS • HEATERS • CRATES

Heil PROCESS EQUIPMENT CORP.
Formerly Heil Engineering Company
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Drawing Compounds

25 YEARS
of Service to
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Wire Products
Industry

PERMAG meets requirements as a lubricant in wire drawing, in both dry and wet processes.

The special lubricating qualities of PERMAG help to bring out a finished product free from imperfections.

Our technical representatives will be glad to consult with you and aid in solving difficult problems arising in wire manufacturing.

Appreciative of past favors from our customers we aim to make our service of still greater value.

MAGNUSON PRODUCTS CORPORATION
Mfrs. Specialized Cleaning Compounds for Industry
Main Office: 50 Court Street., Brooklyn 2, N .Y.
In Canada: Canadian PERMAG Products Ltd. Montreal - Toronto

Philips Introduces New Welding Electrodes

A new type of manual arc welding electrode, designed to improve weld quality while lowering welding costs, will be displayed for the first time at the National Metal Exposition in Philadelphia, October 25-29, by **North American Philips Company, Inc.**, New York.

* * *

THESE new electrodes, available in lime ferritic, iron oxide and organic types, have a special type of coating and offer certain definite advantages. Training time for inexperienced welders is shortened and less expensive quality control is required. High deposition rates and efficiencies result in lower costs per unit of time is obtainable. These new type Norelco contact welding electrodes, two of which can also be used on a semi-automatic basis, permit touchwelding in all welding positions except vertical up and have automatic starting and re-igniting properties. They deposit weld metal of the highest mechanical properties and have deposition rates from 25% to 100% higher than those of standard type electrodes.

* * *

THE electrodes offer high deposition efficiency because of their low spatter losses and special coating. The special type of penetration obtained considerably decreases the possibility of undercutting. Standard size joints can be made with fewer layers as more weld metal per pass is obtainable.

* * *

THE electrodes work satisfactorily with standard welding equipment on AC or DC, reverse or straight polarity. Very high currents, up to 600 amperes for the 5/16" size, may be used.

Two New ACP Bulletins

AMERICAN Chemical Paint Company, Amler, Pa., has issued two new bulletins.

* * *

THE first is entitled, "How to Prepare Metal Surfaces Correctly for Painting" and lists their various surface treatment products, with in-

Investigate

PRE-PLATED WIRE

round or flat

nickel plated
copper plated
brass plated
silver plated
chrome plated rods

FERNICKLON

KENMORE METALS CORP.

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NEW YORK 4, N. Y.
WHitehall 3-5783

structions as to their applicability, methods of applying and the results that may be expected.

* * *

THE second is a technical service data sheet, No. P-100-34, describing "Deoxylyte" treated rinse baths. This discusses titration testing for pH determination and the use of "Deoxylyte" in this connection, treating the subject from a technical angle.

* * *

COPIES of either or both may be had upon application.

Fansteel Acquires Full Control Of Vascoloy-Ramet Corporation

THE entire common stock equity in **Vascoloy-Ramet Corporation** held by Vanadium-Alloys Steel Company, was acquired on September 1st by **Fansteel Metallurgical Corporation,** North Chicago, Illinois, Robert J. Aitchison, president, has announced.

* * *

VASCOLOY-RAMET Corporation was established in 1933 to manufacture and distribute tantalum/tungsten carbide cutting tools, dies and wear-resisting parts. Until recently, two-thirds of the company was owned by Fansteel Metallurgical Corporation who supplies the company with its rare metal materials, and one-third by Vanadium-Alloys Steel Company of Pittsburgh and Latrobe, Pennsylvania. No Vascoloy-Ramet stock has ever been offered for public sale.

* * *

THE Vascoloy-Ramet plant in Waukegan, Illinois, contains 80,000 square feet of floor space, and has complete equipment for production of refractory metal carbide products. Distribution is effected through sales engineering offices in principal cities of the United States and authorized agents throughout the world.

* * *

MR. Aitchison said that Vascoloy-Ramet Corporation will continue to be operated under its own name as a division of Fansteel Metallurgical Corporation. A broadened expansion and integration program will soon be under way.

WIRE DRAWING DIES FOR EVERY REQUIREMENT

PRECISION MADE WIRE DRAWING DIAMOND DIES DESIGNED TO GIVE SUPERIOR RESULTS

DIAMOND TOOLS AND UNIFORMLY GRADED WEST AFRICAN AND BRAZILIAN DIAMOND POWDER

TUNGSTEN CARBIDE ROUND AND SHAPED DIES, TOOLS AND WEAR RESISTING PARTS

RUSCH WIRE DIE CORP.

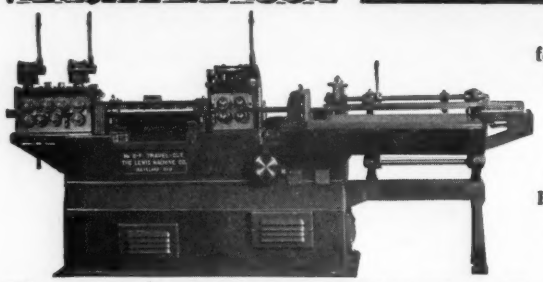
OFFICES AND FACTORY
CROTON-ON-HUDSON, N. Y.

USE THE PROVEN BRAND . . .

Whatever wire product you make, Cortland Brand wire can help you make it better. For wire fabrication of all types, Cortland wire has the right softness or hardness, freedom from surface defects, and correct lubricating properties. There is a Cortland wire in a size and style to fit your requirements.

Cortland BRAND
WICKWIRE BROTHERS, INC., CORTLAND, N. Y.

LEWIS TRAVEL-CUT WIRE STRAIGHTENING and CUTTING Machines



Machines for 1/16" to 3/4" rod
Round
Square
Flat
Hexagon
Ferrous and Non-Ferrous

Automatic
High Speed
Heavy Duty

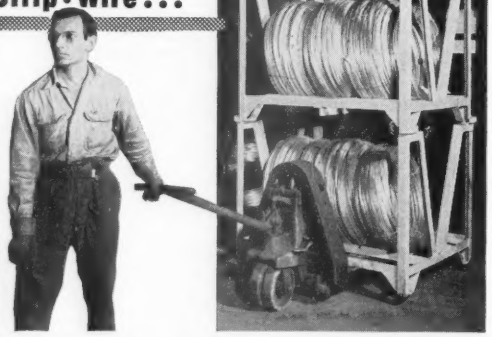
LEWIS

The LEWIS MACHINE Co., 3445 E. 76 St., Cleveland, O.

PALLET RACKS for the Correct Handling of COILED Rod · Flat Strip · Wire . . .

with Hand-Lift or Fork-Lift Trucks

Racks may be used as single units or tiered
Engineered for maximum strength and lightness
Write for full information



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REELS SPOOLS
ALL SIZES
WOOD -- PLYWOOD -- WOOD-METAL
RETURNABLE NON-RETURNABLE
Samples and Prices on Request
DURKEE MFG. CO. PINE RIVER, MINN.

Brass Wire Processing

(*Continued from page* 880)

fluoride solutions are now being used but only sparingly due to the danger involved in handling this type solution.

Handling

HANDLING of wire coils is still one of the most difficult problems of any brass wire mill. The segregation of mixtures, the small lot production and the various positions assumed by the wire at the different operations makes it one of the biggest problems the brass mills have to face. A single system that will simplify handling at the wire blocks, annealing, pickling, drying, etc., is extremely difficult to devise. Wire mills throughout the country where volume production in specific sizes is prevalent can adapt their handling system to the need, but for the varied production and operations found in a brass wire mill, no single system has as yet provided for efficient handling at all operations. Handling equipment in wire brass mills today includes either slings, stands, C hooks, gondolas, racks and containers which are transported by monorails, bridge cranes or trucks.

Summary

IMPROVEMENT in processing of brass wire over the last five years has largely been in improved procedure and improved quality. Emphasis has been placed on reducing costs either by the purchase of modern high speed equipment or by streamlining the mill to reduce handling cost and production delays. Much progress has been made in the field of extrusion to permit the production of a wider range of alloys and improvement in the quality of the product.

* * *

GENERALLY, improvement in the wire field has been in an all around improvement including study of drawing, annealing, lubricants, and general layout and an

analysis of all operations by the mill supervision with aid from the technical staffs.

REFERENCES:

***Metals Handbook ASM.**
***Extrusion Practice — W. W. Cotter and W. R. Clark.**

And the aid of the Laboratory and Technical Staff of the Bridgeport Brass Company.

* * *

Labor Relations

(*Continued from page* 930)

which signed long term contracts this year with wage "escalator" clauses. As in the case of General Motors, these companies are forced to grant wage increases automatically as the cost of living increases.

* * *

BUT they will be in a position to "cash in" on the terms of the contracts which the price curve turns downward.

* * *

New Motor-Generator Catalog

A new catalog on low-voltage direct current motor-generator sets has been issued by **Hanson-Van Winkle-Munning Company** of Matawan, New Jersey, Bulletin G-102. This catalog describes their line of motor-generator sets for all low voltage applications such as electroplating, electrocleaning, anodizing, Manodizing, electropolishing, electrocoloring, electrotyping, electroforming, metals refining and electrolytic production of chemicals.

* * *

THE bulletin lists and illustrates generators ranging in size from 300 amps. to 40,000 amps, at 6 volts to 40 volts. It describes in detail certain special construction features such as brushes, brush holders and rigging commutator risers, bearings, control panels, etc. Included also are general specifications and efficiency curves for generators of various sizes.

* * *

Waterproof and Crepe Paper

In rolls of any size for wrapping coils and reels.

Crepe-Kraft Barrel Liners

THE CREPE-KRAFT COMPANY
DIVISION OF NATIONAL WATERPROOF PAPERS, INC.
Front & Beckett Street, Camden, New Jersey

FITZ WIRE WEAVING LOOMS

for Fly Screen Cloth and other rectangular meshes. These are the former Kintzing Looms, better than ever, and with many improved details. All-steel Warp Drums, both plain and multi-ribbed. All parts for Kintzing Looms, Spool and Robbin Winders, etc. Magnesium alloy shuttles for fine wires.

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Hanover, Pa.

THERMOPLASTIC CABLE SHEATHING KRAFT

for your non-metallis sheathed products.
Strong . . . .
Time-tested . . . .
Water-repellant . . . .
No wax saturation needed.

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1. Floor and Bench Model Machines.
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Warner

BELL-MINE LIME

for

WIRE DRAWING

WARNER COMPANY

BELLEFONTE DIVISION

BELLEFONTE, PA.

Sales Office

Philadelphia — Pittsburgh — New York

The Control and Production of High Carbon Wire

(*Continued from page* 887)

IN the Cleaning House, temperatures, density, and acid concentrations are determined at regular and frequent intervals. These tests provide the cleaner with data by which he can keep his tubs at a high operating efficiency. The test results indicate whether acid should be added, or the tub dumped.

* * *

AT the drawing machines, the stock size, steel grade, die sizes, and surface finishes are checked regularly by the Foremen, as well as by the Mill Inspector. A preliminary guidance test for physical properties is made at the beginning of each shift, and whenever a new size or different grade of steel is started.

* * *

AFTER drawing, all wire is sent to the Physical Testing Laboratory where every coil is tested in accordance with the customers' requirements. The usual test required by specifications will include tensile strength, reduction of area, elongation in a given length, torsion, reverse bending, and various forming tests such as knoting, crimping, bending, etc.

* * *

OCCASIONALLY some aspiring engineer will specify that some unusual test be made and reported. Such determinations as elastic limit, proportional limit, modulus of elasticity, coefficient of expansion, etc., are the more unusual of these, and for any purpose other than giving the wire mill metallurgist high blood pressure, they are quite impractical and superfluous.

ADVERTISING is a service to a magazine's readers. Methods, materials, and machinery were developed under the stress of war. Both editorial matter and advertisements keep you informed on what is happening in industry.

WOOD REELS for WIRE, ROPE and CABLE

Assembled

or

Knocked Down

All sizes

Quick Delivery

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THE NELSON CO.

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IRONSIDES

For the Wire Mill

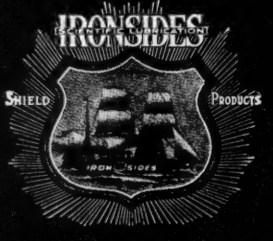
Lubricants

Weatherproof

and

Flame Resistant

Compounds



The Ironsides Company

Columbus 16,

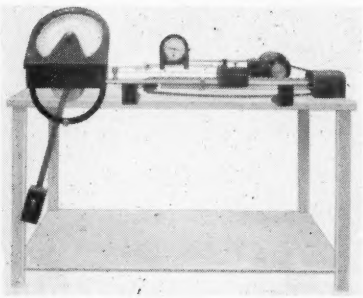
OHIO

EASTWOOD WIRE
CENTRIFUGALLY-CAST FOR QUALITY

Phosphor Bronze } WIRE
Nickel Silver } FLAT WIRE ROD

Eastwood-Nealley
CORPORATION
Belleville 9, New Jersey

TENSILE TESTER FOR LIGHT WIRE



Type 274

Bench Model - Motor Driven

MAXIMUM CAPACITY 25 LBS.
(also Metric)
DUAL RANGE DIAL (fixed readings)
45° RECLINED DIAL
DIAL TYPE ELONGATION INDICATOR

Other models for a broad range of applications available in various capacities up to 1500 lbs. maximum.

AMTHOR
TESTING INSTRUMENT CO. INC.
55 Van Sinderen Ave. Bklyn. 7, N. Y.

Quality, Quantity & Service

(*Continued from page 927*)

The wire rod provider in the central office works in conjunction with the wire drawing provider. He recapitulates the rod requirement from the drawing block lineup, and places a 24-hour rod requirement with the Rod Mill provider. The wire rod provider is responsible for the 24-hour patent furnace lineup, 24-hour cleaning house lineup, and acts as Patented Rod product provider.

* * *

THE Rod Mill provider takes the 24-hour wire rod requirement plus the Shiping Rod Product provider's requirement, and after applying the applicable heats from the billet yard, issues the 24-hour rod mill schedule. The Rod Mill provider whom we previously mentioned by calling him Billet provider, has of course been ordering steel from the open hearth in accordance with the weekly memorandum from the various product schedules, and further making daily releases of preference to keep the billet stock piles at a 2 week supply level of each commonly used grade.

* * *

THE foregoing discussion applies directly to those items coming from 5 gauge rods, and with a slight variation applies also to the orders coming from larger sizes of rod. In the latter case, one of the two rod mills is set on a sequence of size rollings at the beginning of each schedule period. The sequence is so arranged as to supply all reinforcing bars in the first part of the period, followed by rollings of every size of which the mill is capable once during the balance of the period. The latter rollings are constituted by the properly loaded Shipping rod product schedule and a recapitulation of the large size rods required to complete all the other properly loaded mill product schedules. In this case only, material is stocked ahead of an operation to the extent of one schedule period's requirement; however, provisions have been made for this warehousing in process because of

BORAX
for
Wire Drawing

After pickling, BORAX can be applied with one dip; dries in three minutes in an oven temperature of 150° F. to provide a coating that will not check or flake off in storage. Dissolves readily in water and is dust free. BORAX, other than being an excellent vehicle for picking up the drawing lubricant, is rust inhibiting and a natural flux that will facilitate the making of good butt welds. Use BORAX to make better wire at less cost. Used in many mills.

Send for complete particulars

PACIFIC COAST BORAX CO.
51 Madison Ave., New York 10, N.Y.

A Coat of Many Values

HAVE you tried the Oakite CrysCoat* Process for coating ferrous rods and wire? It has five important advantages:

1. Longer die life
2. Cleaner, brighter wire
3. Superior rust-resistance
4. Increased production
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The Oakite Technical Service Representative in your neighborhood will be glad to show how easily you can put the Oakite CrysCoat Process into operation.

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OAKITE
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Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

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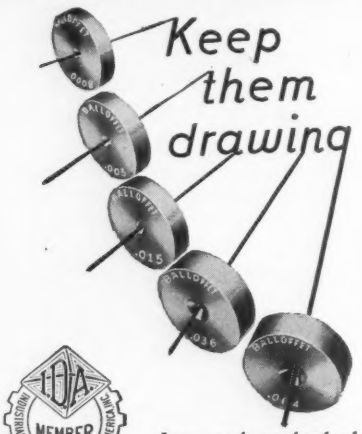
DIAMOND DIES



I.D.A. MEMBER
Industrial Diamond Association of America, Inc.

Large stock on hand of domestic and imported dies available for immediate shipment in sizes from .0004" to .081".

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DIES AND NOZZLE CO., Inc.
6825 Adams St., Guttenberg, N. J.
Quality Diamond Dies Since 1870

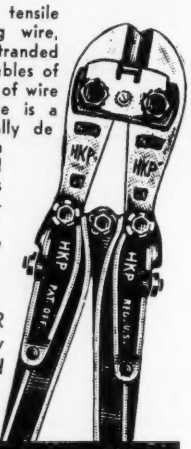
the economic expediency of minimizing extensive rod mill size changes. These rollings are tallied and the notices distributed to the various product providers. Upon receipt of notice that large size rods for a particular order have been rolled, the product provider is able to begin the drawing and finishing of those orders by making them part of his 40-hour wire requirement in the same manner as all other orders.

Daily Shipments

AS orders are completed, the Product Provider's copy of the sales order is turned over to the shipping department. The shipping department in turn loads the material in cars or trucks, and issues a manifest certifying the order has been shipped complete. Copies of these manifests are sent to the product provider who crosses the item from his schedule, to the Order Department which arranges for clearance of the car and notifies the customer of the shipment, and to the billing department which issues an invoice to the customer.

PORTER
Cutters
the POWER *line*

For cutting high tensile strength wire, spring wire, hard wire rope, stranded guy wire, tie wire, cables of all kinds — any kind of wire hard or soft — there is a Porter Cutter specially designed to do each job faster, easier and safer. Porter Cutters are practically standard equipment throughout the entire wire industry.



SEND FOR FOLDER showing the newly designed *improved* Porter Cutters.

H. K. PORTER, INC.
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VIANNEY
Famous Wire Drawing Diamond Dies

All sizes from .080 down to .00039 in stock in New York.

Appropriate profiles available for soft, medium and hard metals or to your specifications.

VIANNEY WIRE DIE WORKS
250 E. 43rd St., New York
V. J. Boulin, Manager

PART IV

THE technical aspects of drawing wire are still the subject of much research. Great progress has been made in the past 20 years, and already many drawing and finishing practices are becoming well defined and to some extent standardized throughout the industry. As practices respecting metal grades, rod sizes, breakdown sizes, coatings, finishes, coil weights, and physical properties become more universally defined and standardized, it will be possible to advance correspondingly in scheduling practices.

Bulletin Covers Grips

A bulletin issued by **Smith Devices**, 331 No. 4th St., Philadelphia 6, Pa., describes a very complete line of industrial grips for rods, cables, drums, barrels, boxes, plates, besides a line of cable binders, trip hooks, package cradles, and so forth. Pictures and descriptions cover each item. A copy of the bulletin will be mailed upon request to those desiring it.

QUALITY DIES FOR EVERY NEED

Diamond and Carbide

When you use Wayne Dies, you are getting MAXIMUM service at MINIMUM cost. Wayne offers you complete service on round, shaped, extrusion and tubing dies.

We also make die machinery and are equipped to rebuild your old equipment.

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200 Pennsylvania Avenue,
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DIAMOND DIES .0006 - .120 DIAMOND POWDER
INDUSTRIAL
AJAX
SUPPLIES INC.
R.R. 4, P.O. Box 66, Fort Wayne Ind.

NEW ENGLAND WIRE DIE CO.
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DIAMOND DIES, DIAMOND POWDERS
Eastern Representative of
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DIAMONDS for WIRE DRAWING DIES and CUTTING TOOLS
DIAMOND POWDER UNIFORM QUALITY
CHAMPION DIAMOND COMPANY, INC. 551 Fifth Ave., New York 17

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DRAWING LUBRICANTS
Hans C. Bick, Inc.
READING, PA.

Wire Drawing Diamond Dies

COCHAUD
WIRE DIE CORPORATION
300 W. 56th St., NEW YORK
Tel. COl. 5-1340

Outstanding Personalities of the Wire Industry

(*Continued from page 961*)

and bookbinders' machinery. Currently the firm is best known as the producer of the Stokes-Standard hydraulic toggle type molding press.

Forrest E. Allen Joins International Nickel

FORREST E. Allen, formerly a member of the faculty of Iowa State College in the Department of Mechanical Engineering, and Associate Professor in charge of the instruction on metallurgy, has joined the Development and Research Division of The International Nickel Company, Inc., it was announced by T. H. Wickenden, Vice President in charge of that Division.

* * *

HE will make his headquarters at New York and will work on the Company's Educational Program with universities and colleges in the United States.

* * *

MR. Allen has had considerable practical and consulting experience during his association with Iowa State College in the past nine years. He received a B. S. degree in Mechanical Engineering from Michigan State College in 1936 and an M. S. degree in Mechanical Engineering from the University of Michigan in 1939.

* * *

HE is a member of the American Foundrymen's Society, the American Society of Engineering Education and the American Society for Metals to which he was Chairman-elect of the Des Moines Chapter for the 1948-1949 term.

Hamersley Sales Promotion Manager for Firth Sterling

LESTER B. Hamersley has been appointed sales promotion manager by **Firth Sterling Steel & Carbide Corporation,** with headquarters at McKeesport, Pennsylvania. Mr. Hamersley was formerly assistant sales manager of Signode Steel Strapping Company of Chicago and previously division manager of Fairbanks Morse & Company.

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WIRE DIE CORPORATION
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WIRE DRAWING, EXTRUSION, HEADING and SHAPED DIES
Mandrels and Wear Resisting Tungsten Carbide Parts.
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Finishing and Recutting Diamond and Carbide
Wire Drawing Dies our specialty
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ALL SIZES
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EISLER TRANSFORMERS

* STANDARD and SPECIAL *
AIR — OIL or WATER-COOLED
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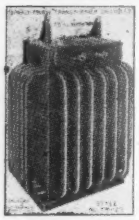

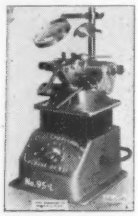

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* * *

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* * *

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- *** Prepare a job advancement table showing the steps by which each worker can advance within the company.**
- *** Spell out the requirements for promotion.**
- *** If the company has a training program, information should be given on the method of selecting candidates.**
- *** Workers should be advised of trade school, night high school, or other outplant courses.**

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Formation and Properties of Martensite on the Surface of Wire Rope

(Continued from page 875)

the higher carbon martensite cracks on bending depending on the severity of bending and the carbon content. In martensite on .55% carbon and lower carbon steel rope wire, tearing rather than cracking takes place and requires considerably more bending than do the higher carbon steels.

* * *

THESE tests suggest that where service conditions tend to form martensite, the damaging effect of the martensite can be reduced by lowering carbon content and if the carbon content is .55% or lower, the danger of broken wires from martensite formation is greatly reduced.

* * *

ACKNOWLEDGEMENT

The author wishes to express his appreciation to the John A. Roebling's Sons Company for permission to publish this paper; to Mr. E. M. Yard of the John A. Roebling's Sons Company for the mathematical solution; and to Messrs. R. H. Hertzog and H. M. Gruner for the experimental work and data.

* * *

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Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Williams, A. R., Machy Co., Ltd., Toronto, Canada.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CASTINGS—Wire Mill
Scudder, E. J. Fdry. & Mach. Co., Trenton, N.J.

CEMENTS—Acid Proof
Ceilcote Co., The, Cleveland, Ohio.
Sauereisen Cements Co., Pittsburgh, Pa.

CEMENTS—Refractory
Norton Co., Worcester, Mass.
Sauereisen Cements Co., Pittsburgh, Pa.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corporation, Brooklyn, N. Y.
Metal & Thermit Corp., New York, N. Y.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CHEMICALS—Stearates
American Cyanamid Co., Industrial Chemicals Division, New York, N. Y.

CLEANERS—Metal and Hand
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila, Pa.
Magnus Chemical Co., Garwood, N. J.
Metal & Thermit Corp., New York, N. Y.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Bronze Die Casting Co., Pittsburgh Pa.
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
General Chemical Division
Allied Chemical & Dye Corp., New York, N.Y.
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.
Metal & Thermit Corp., New York, N. Y.
Morgan Construction Co., Worcester, Mass.
Nukem Products Corp., Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH TESTERS—
Scott Testers, Inc., Providence, R. I.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Spencer Steel Division, Colorado Fuel & Iron Corp., Buffalo, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
General Chemical Division
Allied Chemical & Dye Corp., New York, N.Y.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J. Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

COLD HEADERS—
Ajax Manufacturing Co., Cleveland, Ohio.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Magnus Chemical Co., Garwood, N. J.
Engis Equipment Co., Chicago, Ill.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
General Chemical Division
Allied Chemical & Dye Corp., New York, N.Y.
Metal & Thermit Corp., New York, N. Y.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison N. J.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery Inc., Pawtucket, R.I.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, New York.
Vascoloy-Ramet Corp., North Chicago, Ill.
Willey's Carbide Tool Co., Detroit, Mich.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Champion Diamond Co., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Champion Diamond Co., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Indiana Wire Die Co., Fort Wayne, Ind.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND TOOLS—
Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Cold Heading
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.

WHERE TO BUY, Continued

Hoosier Carbide Die Co., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Metal Carbides, Corporation, Youngstown, Ohio.
Vascoloy-Ramet Corp., No. Chicago, Ill.

DIES—Diamond

Ajax Industrial Supplies, Inc., Fort Wayne, Ind
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Eyelet

Hoosier Carbide Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Lead Extrusion

Carboloy Co., Inc., Detroit, Mich.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Pointing

Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting

Ajax Industrial Supplies Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., Glendale, L. I., N. Y.
Metal Carbides, Corporation, Youngstown, Ohio.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing

Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Eastern Tungsten Carbide Co., Newark, N. J.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., Glendale, L. I., N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich
Williams, A. R., Machy Co., Ltd., Toronto Canada.

DIES—Special Shapes, Etc.

Eastern Carbide Corp., New Rochelle, N. Y.
Hoosier Carbide Die Co., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.

DIES—Tantalum Carbide

Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.

DIES—Tubing

Hoosier Carbide Die Co., Ft. Wayne, Ind.
Rusch Wire Die Corp., Croton-on-the-Hudson, N.Y.

DIES—Tungsten Carbide

Balloffet Dies & Nozzle Co., Inc., Guttenberg, N.J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Hoosier Carbide Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., Glendale, L. I., N. Y.
Metal Carbides, Corporation, Youngstown, Ohio.
Rusch Wire Die Corp. Croton-on-the-Hudson, N.Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Wks., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.
Williams, A. R., Machy Co., Ltd., Toronto, Canada.

DRAW BENCHES—

(See MACHINERY—Draw Benches)

DRUMS—Flange Steel

Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.

DRUMS—Vulcanizing

Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—

Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Modern Plastic Machinery Corp., Lodi, N. J.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N.Y.

ENGINEERS—Consulting Spring Design

Carlson Co., The, New York, N. Y.

ENGINEERS—Consulting Wire Mill

Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing

Davis, R. L., Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Williams, A. R., Machy. Co., Ltd., Toronto, Canada

EYELETS—Brass or Zinc

Platt Bros., & Co., The, Waterbury, Conn.

FLUXES—Soldering

American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—

American Chemical Paint Co., Ambler, Pa.
Parkin, Wm. M. Co., Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—

Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing

Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Harper Electric Furnace Corp., Niagara Falls, N.Y.
Hayes C. I., Providence, R. I.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic

Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing

Electric Furnace Co., Salem, Ohio.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Rockwell, W. S., Co., Fairfield, Conn.

FURNACES—Bright Annealing

Electric Furnace Co., Salem, Ohio.
Furnace Engineers Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N.Y.
Rockwell, W. S., Co., Fairfield, Conn.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric

Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N.Y.
Hayes, C. I., Providence, R. I.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Galvanizing Equipment

Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing

Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N.Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., The, Cleveland, Ohio.

FURNACES—Lead Melting

Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Robertson, John, Co., Brooklyn, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing

Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Furnace Engineers, Inc., Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing

Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N.Y.
Furnace Engineers, Inc., Pittsburgh, Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (Oil, Gas, Electric)

Ajax Electric Co., Inc., Philadelphia, Pa.

FURNACES—Resistance Heating, Strand

Trauwood Engineering Co., Cleveland, Ohio

FURNACES—Salt Bath

Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Wire, Strip & Sheet

Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N.Y.
Furnace Engineers, Inc., Pittsburgh, Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corporation, Toledo, O.
Trauwood Engineering Co., The, Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING EQUIPMENT—

Hanson-Van Winkle-Munning Co., Matawan, N.J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GALVANIZING FLUXES—

Hanson-Van Winkle-Munning Co., Matawan, N.J.

GALVANIZING KETTLES—

National Annealing Box Co., Washington, Penna.

GRINDERS—Roll

Norton Co., The, Worcester, Mass.

HAMMERS—Swaging

Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling

Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

HOOKS—Pickling & Lining

Gordon, Clark, E., Detroit, Mich.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

INHIBITORS—Pickling

American Chemical Paint Co., Ambler, Pa.

WHERE TO BUY, Continued

Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M. Co., Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Mach'y. Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Du Pont de Nemours, E. I., Co., Wilmington, Del.
General Electric Co., Schenectady, N. Y.
Martin, Glenn L. Company, Baltimore, Md.
Owens Corning Fiberglas Corp., Toledo, O.
Standard Varnish Wks., Staten Island, N. Y.
Twitchell, E. W., Philadelphia, Pa.
Warren Thread Works, Inc., W., New York, N.Y.

INSULATING MATERIALS—PAPER—For Electric Wire Cable.
Merrimac Paper Co., New York, N. Y.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Morgan Construction Co., Worcester, Mass.
Roos, Tool & Mfg. Co., Montclair, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.
Sauereisen Cements Co., Pittsburgh, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Ironsides Co., The, Columbus, Ohio.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Ironsides Co., The, Columbus, Ohio.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill.
Swift & Company, Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Barbed Wire
Reed & Richards Transatlantic Co., Inc., New York, N. Y.

MACHINERY—Braiding
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Brazing
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Rockwell, W. S., Co., Fairfield, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Coilers
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (used), New York, N. Y.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Williams, A. R., Machy Co., Ltd., Toronto, Canada.
Wire & Textile Machinery Inc., Pawtucket, R. I

MACHINERY—Cold Heading
Ajax Manufacturing Co., Cleveland, Ohio.
National Machinery Company, Tiffin, Ohio.

MACHINERY—Copper Wire Drawing and Rolling
Aetna Standard Eng'g Co., The, Youngstown, O
American Insulating Mach'y Co., Phila., Pa.
National Machinery Exchange (used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
National Erie Corp., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Hallden Machine Co., The, Thomaston, Conn.
Lewis Machine Co., The, Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N Y
Nilson Machine Co., A. H., Bridgeport, Conn.
Porter, H. K. Inc., Everett, Mass.
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Die Making
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel & Carbide Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Roos Tool & Mfg. Co., Montclair, N. J.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Aetna Standard Eng'g Co., The, Youngstown, O
Ajax Manufacturing Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Edging
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
Modern Plastic Machinery Co., Lodi, N. J.
National Erie Corp., Erie, Pa.
Robertson John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R. I

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Modern Plastic Machinery Co., Lodi, N. J.
National Erie Corp., Erie, Pa.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Bruckner-Mitchell, Inc., New York, N. Y.
Fitz Water Wheel Company, Hanover, Pa.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail, Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Fab-Weld Corporation, Philadelphia, Pa.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Black Industries, Cleveland, Ohio
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Company, Tiffin, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Pickling
Gordon, Clark E., Detroit, Michigan.
Youngstown Welding & Engineering Company, Youngstown, Ohio.

WHERE TO BUY, Continued

MACHINERY—Plating Electrolytic
Hanson-Van Winkle-Munning Co., Matawan, N.J.
Kenmore Metals Corp., New York, N. Y.

MACHINERY—Pointing
Aetna Standard Eng'g Co., The, Youngstown, O.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rubber Insulating
Royle, John & Sons, Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R. I.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Screw Wire
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Black Industries, Cleveland, Ohio
Bruckner-Mitchell, Inc., New York, N. Y.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Kenmore Metals Corp., N. Y.
National Erie Corporation, Erie, Pa.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Samuel, E. A., Machine Co., Chicago, Illinois
Scudder, E. J., Fdry & Mach Co., Trenton, N J.
Siogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Boyd, Charles P. Corp., Philadelphia, Pa.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Mach'y Exch. (Used), New York, N.Y.
Modern Plastic Machinery Co., Lodi, N. J.
New England Butt Co., Providence, R. I.
Plymouth Wire & Cable Corp. (Used), Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Mach'y, Inc., Pawtucket, R.I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N.Y.
Samuel, E. A., Machine Co., Chicago, Illinois.
Sleeper & Hartley, Inc., Worcester, Mass.
Williams, A. R., Machy Co., Ltd., Toronto, Canada.

MACHINERY—Staple
Reed & Richards Transatlantic Co., Inc., New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Steel Bale Ties
Reed & Richards Transatlantic Co., Inc., New York, N. Y.

MACHINERY—Straightening
Ajax Manufacturing Co., Cleveland, Ohio.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Reed & Richards Transatlantic Co., Inc., New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Stranding
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Plymouth Wire & Cable Corp. (Used), Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Ruesch, H. J., Machine Co., Newark, N. J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Swaging
National Erie Corp., Erie, Pa.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Testing Physical
American Optical Co., Buffalo, N. Y.
Scott Testers, Inc., Providence, R. I.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L. Elec. Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila, Pa.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
National Erie Corp., Erie, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila, Pa.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Aetna Standard Eng'g Co., The, Youngstown, O
Industrial Ovens, Inc., Cleveland, Ohio.
Modern Plastic Machinery Co., Lodi, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Cutting
Jersey Specialty Co., Little Falls, N. J.

MACHINERY—Wire Drawing
Aetna Standard Eng'g Co., The, Youngstown, O
Ajax Manufacturing Co., Cleveland, Ohio.
American Insulating Mach'y Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Eisler Engineering Co., Newark, N. J.
National Mach'y Exch. (Used), New York, N.Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.
Reed & Richards, Transatlantic, Inc., New York,
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Spooling
Jersey Specialty Co., Little Falls, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N.Y.

MACHINERY—Wrapping Wire Coils
Angier Corporation, Framingham, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail, Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Fab-Weld Corporation, Philadelphia, Pa.

MATERIAL—Resistance Heating Strand
Trauwood Engineering Co., Cleveland, Ohio.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A. Sons Co., Trenton, N. J.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
U. S. Steel Export Co., New York, N. Y.

NAIL DIE GRINDERS
Reed & Richards Transatlantic Co., Inc., New York, N. Y.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Chase Brass & Copper Co., Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.

OPTICAL EQUIPMENT—Metallurgical
American Optical Co., Buffalo, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

OVENS—Dehydrogenizing
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engr. Corp., New York, N. Y

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engr. Corp., New York, N. Y

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

WHERE TO BUY, Continued

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Angier Corp., The, Framingham, Mass.
Crepe-Kraft Company, The, Division
National Waterproof Papers, Inc., Newark, N. J.

PAPER—For Coil Wrapping and Corrosion Prevention
Angier Corp., The, Framingham, Mass.
Crepe-Kraft Company, The, Division
National Waterproof Papers, Inc., Newark, N. J.

PAPER TESTERS—
Scott Testers, Inc., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D.C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin, Wm. M., Co., Pittsburgh, Pa.

PICKLING—Hooks, etc. Acid Resisting
Gordon, Clark E., Detroit, Mich.

PICKLING TANK LININGS—
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.
Nukem Products Corp., Buffalo, N. Y.
Sauereisen Cements Co., Pittsburgh, Pa.

PIPES & FITTINGS—Acid Resistant
Ceilcote Co., The, Cleveland, Ohio.
Haveg Corp., Newark, Del.
Heil Process Equipment Corp., Cleveland, Ohio.
Knight, Maurice A., Akron, Ohio.
Nukem Products Corp., Buffalo, N. Y.

PLASTIC TESTERS—
General Chemical Division,
Allied Chemical & Dye Corp., New York, N.Y.
Scott Testers, Inc., Providence, R. I

PLATING PROCESS—Electrolytic
Hanson-Van Winkle-Munning Co., Matawan, N.J.
Kenmore Metals Corp., N. Y.

PNEUMATIC CYLINDERS
Entwistle, James L. Co., Pawtucket, R. I.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

POTS—Lead Melting
National Annealing Box Co., Washington, Pa.
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Potter, Neil C., Newark, N. J.
Standard Industrial Compounds Co., Chicago, Ill

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J., Fdy & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Sjogren Tool and Machine Co., Auburn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STANDS—
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Drawn Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS & SPOOLS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS & SPOOLS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS & SPOOLS—Shipping and Shop
Aerometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Clark, J. L. Mfg. Co., Rockford, Illinois.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Takeoff
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Hazardville, Conn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Drawing
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS & SPOOLS—Wooden
Acrometal Products, Inc., Minneapolis, Minn.
American Woodworking Co., Chicago, Illinois.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Nelson, Co., The, Baltimore, Md.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing, Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N.Y.

RODS—Nickel Alloy
Eastwood Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N.Y.

RODS—Stainless Steel
Armco Steel Corp., The, Middletown, Ohio.

RODS—Wire—Non-Ferrous
American Brass Co., The Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Portsmouth Steel Corp., Portsmouth, Ohio.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O

ROPE—Wire
American Steel & Wire Company, Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel, Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket, R. I

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

SOAPS—Industrial and Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa
Bick, Hans C., Inc., Reading, Pa.
Magnus Chemical Co., Garwood, N. J
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison N. J.
Potter, Neil C., Newark, N. J.
Swift & Company, Chicago, Ill.

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass

STRIP—Brass and Non-Ferrous
Chase Brass & Copper, The Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.

WHERE TO BUY, Continued

Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Roebling's, John A., Sons Co., Trenton, N. J.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off

Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

TANK—Compound

Haveg Corp., Newark, Del.
Nukem Products Corp., Buffalo, N. Y.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling

Haveg Corp., Newark, Del.
Nukem Products Corp., Buffalo, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Knight, Maurice A., Akron, Ohio.
Sauereisen Cements Co., Pittsburgh, Pa.

TANKS—Steel

Mossberg Pressed Steel Corp., Attleboro, Mass.
Rockwell, W. S., Co., Fairfield, Conn.
National Annealing Box Co., Washington, Penna.

TENSILE TESTERS—

Amthor Testing Instrument Co., Brooklyn, N. Y.

TINSEL—Cords, Decorative

Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Electric Conductor

Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Electric Resistance

Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Lame, Silver and False Gold

Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Thread, Silver and False Gold

Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TINSEL—Thread, Decorative

Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.
North American Philips Co., Inc., New York, N.Y.

TOOLS—Wire Cutting

Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—

Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels

Entwistle, James L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

TRAVERSE MECHANISMS—

Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket. R. I.

TUBE BENDERS AND FORMERS—

O'Neil-Irwin Mfg. Co., Lake City, Minn.
Ruesch, H. J. Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Resistant

Haveg Corp., Newark, Del.

VARNISHES—For Insulation

General Electric Co., Schenectady, N. Y.
Standard Varnish Wks., Staten Island, N. Y.

VULCANIZERS—

Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—

American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt

Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Sciaky Bros., Inc., Chicago, Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous

American Insulating Mach'y. Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy, Inc. Pawtucket, R. I.

WIRE—Aluminum

Aluminum Co. of America, Pittsburgh, Pa.
Malin & Co., Cleveland, Ohio.

WIRE—Barbed

Portsmouth Steel Corp., Portsmouth, Ohio.

WIRE—Cast

Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading

American Steel & Wire Co., Cleveland-Chicago, New York.
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Company, St. Louis, Mo.
Portsmouth Steel Corp., Portsmouth, Ohio.
Roebling's John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric

American Brass Co., The, Waterbury, Conn.
Chase Brass & Copper, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Enameled for Coils

North American Philips Co., Inc., New York, N.Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers

American Steel & Wire Co., Cleveland-Chicago & New York.
Armco Steel Corp., The, Middletown, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper, Waterbury, Conn.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Company, St. Louis, Mo.
Pittsburgh Steel Company, Pittsburgh, Pa.
Portsmouth Steel Corp., Portsmouth, Ohio.
Roebling's, John A., Sons Co., Trenton, N. J.
Seneca Wire & Mfg. Co., The, Fostoria, Ohio.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., of Colorado Fuel & Iron Corp., Buffalo, N.Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music

American Brass Co., The, Waterbury, Conn.
American Steel & Wire Co., Cleveland, Chicago-New York.
Columbia Steel Co., San Francisco, Calif.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio.
Paramount Wire Co., New York, N. Y.
Plymouth Wire & Cable Corp., Worcester, Mass.
U. S. Steel Export Co., New York, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE—Nickel & Nickel Alloy

Eastwood-Nealley Corp., Belleville, N. J.
International Nickel Co., Inc., New York, N. Y.

WIRE—Nickel Silver and Phosphor Bronze

American Brass Co., The, Waterbury, Conn.
Chase Brass & Copper, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Non-Ferrous to Specification for Special Purposes

American Brass Co., The, Waterbury, Conn.
Chase Brass & Copper, Waterbury, Conn.
Eastwood-Nealley Corp., Belleville, N. J.
Hudson Wire Co., Ossining, N. Y.
North American Philips Co., Inc., New York, N.Y.
Paramount Wire Co., New York, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn

WIRESERVING—Paper and Cotton

Paramount Wire Co., New York, N. Y.

WIRE—Spring

American Brass Co., The, Waterbury, Conn.
Armco Steel Corp., The, Middletown, Ohio.
American Steel & Wire Co., Cleveland - Chicago
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Indiana.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel

American Steel & Wire Co., Cleveland-Chicago-New York.
Armco Steel Corp., The, Middletown, Ohio.
Columbia Steel Co., San Francisco, Calif.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Pittsburgh Steel Company, Pittsburgh, Pa.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel

Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Firth-Sterling Steel & Carbide Corp., Mc-Keesport, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Paramount Wire Co., New York, N. Y.
Pittsburgh Steel Company, Pittsburgh, Pa.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

WIRE—Straightening and Cutting—

Paramount Wire Co., Inc., New York, N. Y.
Pittsburgh Cut Wire Co., Pittsburgh, Pa.

WIRE—Zinc

Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial

Roebling's John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Cortland, N. Y.
Wickwire-Spencer Steel Division of Colorado Fuel & Iron Corp., Buffalo, N. Y.

WIRE TESTERS—

Scott Testers, Inc., Providence, R. I.

WIRE, WEAVING—Non-Ferrous

American Brass Co., The, Waterbury, Conn.
Chase Brass & Copper, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Paramount Wire Co., New York, N. Y
Portsmouth Steel Corp., Portsmouth, Ohio.

WRAPPING PAPER—Creped

Angier Corporation, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J

YARNS & TAPES—

Du Pont de Nemours, E. I., Co., Wilmington, Del
General Electric Co., Schenectady, N. Y.
Owens Corning Fiberglas Corp., Toledo, Ohio.
Twitchell, E. W., Philadelphia, Pa.
Warren Thread Works, Inc., W., New York, N.Y.

YARN TESTERS—

Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY
ESTABLISHED 1845
PATERSON 3, NEW JERSEY, U. S. A.

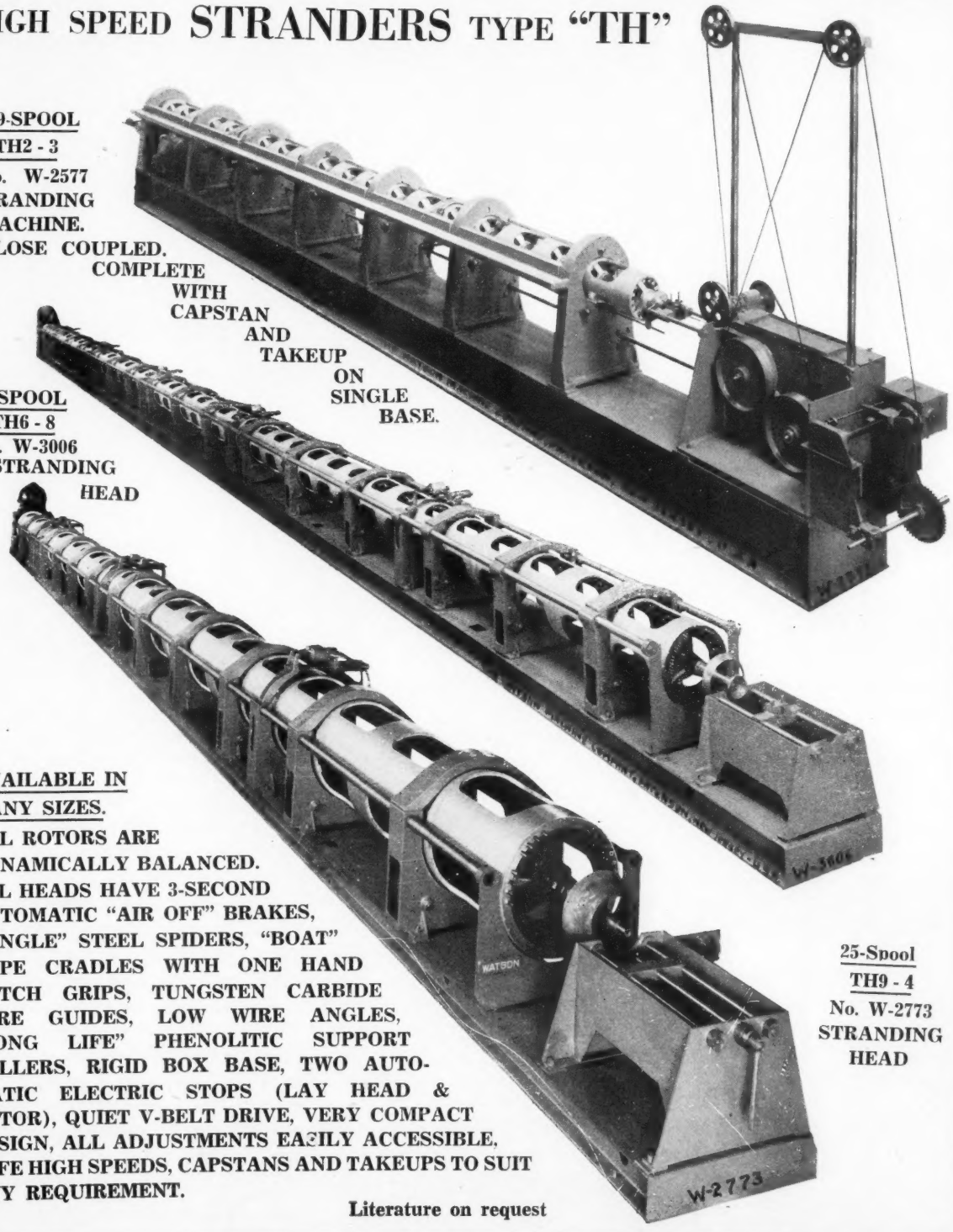
Wire & Wire Products
October, 1948

ELECTRICAL WIRE AND CABLE, WIRE ROPE AND CORDAGE MACHINERY

HIGH SPEED STRANDERS TYPE "TH"

19-SPOOL
TH2 - 3
No. W-2577 STRANDING MACHINE. CLOSE COUPLED. COMPLETE WITH CAPSTAN AND TAKEUP ON SINGLE BASE.

46-SPOOL
TH6 - 8
No. W-3006 STRANDING HEAD



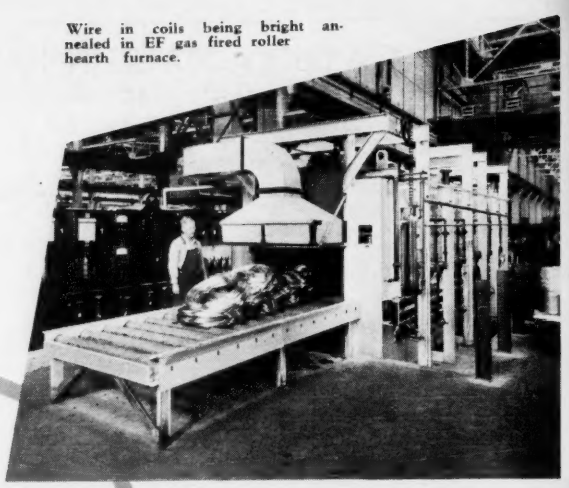
25-Spool
TH9 - 4
No. W-2773 STRANDING HEAD

AVAILABLE IN MANY SIZES.

ALL ROTORS ARE DYNAMICALLY BALANCED. ALL HEADS HAVE 3-SECOND AUTOMATIC "AIR OFF" BRAKES, "SINGLE" STEEL SPIDERS, "BOAT" TYPE CRADLES WITH ONE HAND LATCH GRIPS, TUNGSTEN CARBIDE WIRE GUIDES, LOW WIRE ANGLES, "LONG LIFE" PHENOLITIC SUPPORT ROLLERS, RIGID BOX BASE, TWO AUTOMATIC ELECTRIC STOPS (LAY HEAD & ROTOR), QUIET V-BELT DRIVE, VERY COMPACT DESIGN, ALL ADJUSTMENTS EASILY ACCESSIBLE, SAFE HIGH SPEEDS, CAPSTANS AND TAKEUPS TO SUIT ANY REQUIREMENT.

Literature on request

Wire on reels being bright annealed uniformly and continuously in EF gas fired radiant tube bulkhead tray type furnace.



Wire in coils being bright annealed in EF gas fired roller hearth furnace.

EF RESEARCH, EF DESIGN and EF EXPERIENCE

assures users a maximum of long, highly efficient trouble free operation

EF bell type furnace for annealing wire or strip. Has forced circulation to improve heating rate, temperature distribution and uniformity.

● For more than 30 years the initials "EF" have symbolized the most advanced engineering accomplishment, and utmost dependability in the furnace heat treatment of ferrous and non-ferrous materials and parts.

EF engineers conceived and developed the first automatic and continuous heat treating, quench and drawing equipment, that revolutionized all previous furnace practices. They pioneered and perfected the use of endothermic, exothermic and other special atmosphere treatments, which greatly advanced the metallurgical processing of metals, resulting in closer physical tolerances, and permitting the successful use of brazing for joining assemblies of metal parts.

EF developed the first continuous furnace—using low cost atmospheres—for bright annealing steel and non-ferrous strip and wire; and many other devices which are still available only in EF design.

These include the EF radiant tube with heat exchanger which assures extremely high combustion efficiency; the EF cast alloy electric heating elements; EF roller design and mounting that minimizes servicing and maintenance, and other facilities that assure uniform temperatures throughout the furnace, accurate control of heat input within the required limits, reduced maintenance, high hourly outputs, and uniform, low cost, dependable operation.

Furnished in a wide variety of types, designs, and sizes, individually engineered to your particular requirement—electric, gas, or oil fired.

Let EF engineers, with their long and outstanding successful experience in all phases of furnace operation, work with you on your next heat treating job!

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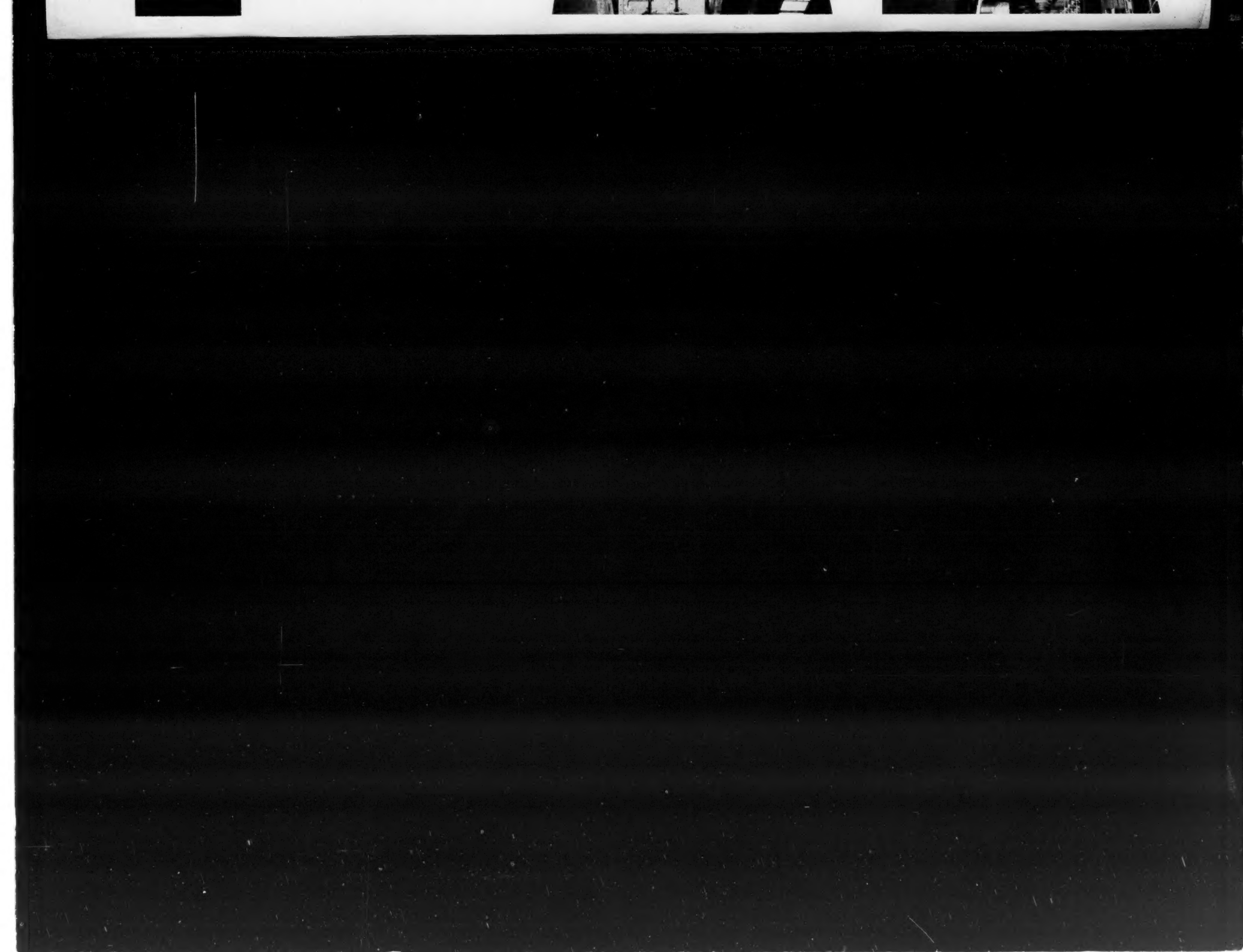
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES
FOR ANY PROCESS, PRODUCT OR PRODUCTION

Salem-Ohio